AGRICULTURAL ENGINEERING

THE JOURNAL OF THE

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS

E. A. WHITE, President FRANK P. HANSON, Secretary-Treasurer

Publication Office, St. Joseph, Michigan. Headquarters of the Society, Station A, Ames, Iowa.

AGRICULTURAL ENGINEERING is published monthly by the Society under the editorial and business management of the Publication Committee

RAYMOND OLNEY, *Chairman* J. B. DAVIDSON FRANK P. HANSON

Contributions of interest and value to the agricultural engineering profession are solicited from members of the Society and others. Communications relating to editorial and advertising matters should be addressed to the Chairman of the Publication Committee: Raymond Olney, St. Joseph, Michigan.

Subscription price to non-members of the Society, $3.00 a year, 30 cents a copy; to members of the Society, $2.00 a year, 20 cents a copy. Postage to Canada, 50 cents additional; to foreign countries, $1.00 additional.

Application for entry as second-class matter at the post office at St. Joseph, Michigan, pending.

Volume II JUNE, 1921 Number 6

CONTENTS

RESULT OF IMPROPER BARN ROOF CONSTRUCTION 123

By Ray W. Carpenter

SPECIFICATIONS FOR FARMING OPERATIONS 124

By O. V. P. Stout

HOW EXPLOSIVES HELP DEVELOP WASTE LAND 129

By Arthur W. Wilson

TILE DRAINAGE INVESTIGATIONS IN NORTH CAROLINA 133

By H. M. Lynde

AGRICULTURAL ENGINEERING DEVELOPMENT 136

Edited by R. W. Trullinger

A. S. A. E. AND RELATED ACTIVITIES 140

AGRICULTURAL ENGINEERING

Volume 2 | JUNE, 1921 | Number 6

A Result of Improper Barn Roof Construction

By **Ray W. Carpenter**

Mem. A.S.A.E. Specialist in Farm Engineering, University of Maryland

THE barn shown in the pictures on this page happened to stand in the path of a near-tornado with the disastrous and quite unusual results shown. An inspection of the plans from which the barn was built and of the wreckage of the barn revealed several interesting facts, which it is believed should be of value to designers and builders of farm structures. Especially is this true in view of the fact that this barn was built with a self-supporting roof of the type now being constructed almost to the exclusion of other types. The barn is 36 feet by 66 feet, with 14-foot studding, giving a hay mow of about 90 tons capacity. This mow was almost empty at the time of the accident. It is worthy of mention that this barn was saved from complete destruction by the fact that the sills were securely bolted to the foundation.

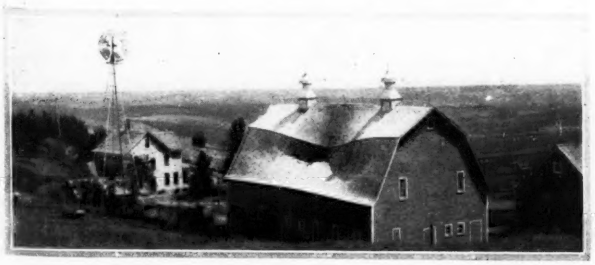
Examination of the collapsed portion of the roof showed that the failure was due to two causes, insufficient bracing and extreme carelessness in construction.

Let us first consider the feature of careless construction. Notice that the picture shows just above the hole in the roof, a long straight crack. This was caused by the fact that the roof sheathing boards had been so cut that the ends of five consecutive boards came upon the same rafter at this point and for the next nine sheathing boards below; the ends of every one came either upon this same rafter or the one just adjacent to it. The joint between any two boards is a weak point. When fourteen such points occur in a group, as in this case, the resulting weakness is great. With a roof 66 feet long and with this faulty construction directly in the center of it, it is not strange that it gave way under the strain of a heavy wind. Any contractor who would allow such a condition to occur is guilty of extreme carelessness.

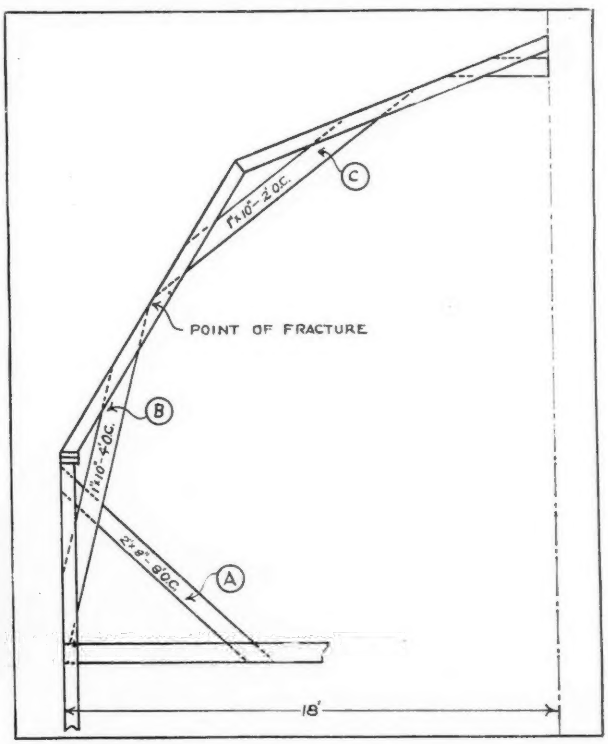
The details of construction of the roof are shown in the drawing. The upper braces, C, consisting of a 1-by-10-inch piece on each rafter, had remained intact, and apparently possessed ample strength. A crosstie from the rafter joint to the brace would, however, be good practice. The lower braces, B, had failed badly. They were twisted, bent, or broken. Evidently the mistake in the design of this roof had been to consider B as a tension-resisting member, whereas it had been called upon to resist compression. One-inch material of any length is of course almost valueless for this purpose.

In the writer's judgment safe construction would call for brace B to extend from the floor to a joint with brace C. It should be of two-inch material, and be stiffened by two or three crossties to the rafter and studding. A very effective brace for this point is made of two 1-by-10-inch pieces, one on either side of the rafter. These pieces are blocked apart by two 1-by-18-inch strips which extend to the rafter, this serving also as crossties. This gives the brace an effective thickness of four inches.

Braces A are sometimes omitted from barns, but this should never be permitted. In the case under discussion they had clearly been of great help. One important function which they perform is to distribute side thrusts throughout the structure, instead of allowing them to be concentrated at a few points. Their other function, to prevent the spreading of the walls due to the weight of the roof, is well understood. Spaced eight feet apart, they take up surprisingly little room for the valuable service which they render.



Poor design and bad workmanship each had a share making possible the peculiar failure shown here



Specifications for Farming Operations

By O. V. P. Stout

Mem. A.S.A.E., Consulting Engineer, and President and General Manager of The Central Farming Corporation, Lincoln, Nebraska

OUR company has had and will continue to have occasion to let contracts for farming operations. In drawing up such contracts heretofore we have included some more or less scantily considered specifications. Our experience has impressed upon us that this matter of specifications for farming operations is worthy of more extended consideration. There are no doubt others who would welcome and use a set of such specifications if presented in a well considered, practical form.

The following material is the initial attempt on the part of our agriculturalist, Mr. Val Kuska, and the writer to produce such a set of specifications. We have not deluded ourselves with the thought that either perfection or completeness in either form or substance have been even approached. If we ever do have a reasonably complete and perfect set of working specifications for farming operations it will be the result of a growth to which many will have contributed, as in the case of specifications for engineering construction.

In general we have aimed to adhere to the principle of specifying results rather than methods. This policy could not, of course, be followed without many exceptions. Its adoption so far as seemed practical has made it desirable to preface the specifications proper with some suggestions and informative material designed to aid in both the administration and the discharge of contracts embodying the specifications.

Under a perfect or ideal set of specifications a contract could be let, and honest and intelligent contractors and operators working to conform to the specifications would produce the desired result. On the other hand, if the contractor or his foreman and operators were otherwise than honest and intelligent, the desired result would not materialize, but the specifications would still be of benefit, fully as great as in the other case, in that they would make it possible to point out definitely the particulars in which the work fell short of what it should be, and either the full obligation of payment under the contract would not accrue, or the work in greater or less part would have to be done over in order to discharge the contract.

It is hoped that these specifications, in spite of their imperfections, will be sufficiently definite and practical to facilitate administration on the part of those for whom farming operations are performed under contract, to indicate to the contractor the character of work which he must do in order that he may be assured of his pay, and to narrow the limits of opportunity for both accidental and deliberate misunderstanding and disputes.

We shall be glad to receive such comments and criticism from qualified persons on the preface and specifications as may occur to readers having had experience in such matters.

PREFACE

This preface is not a part of the specifications proper which follow and does not modify or alter them in any way. It is intended to serve the purpose of information and suggestion to the end that the specifications may be made as completely effective as possible.

The primary objects aimed at in the specifications for plowing fields for cropping are, except in the case of certain soils hereinafter noted, the following:

1. The accomplishment in the highest practicable degree of pulverization of the soil as it is turned over by the plow, to the end that a suitable seedbed may be obtained with the minimum of preparation in addition to the plowing. Proper plowing, as compared with inferior work, will save at least one cultivation in the preparation of a seedbed of any given degree of excellence.

The chief expedients to which attention should be given in aiming at pulverization of the soil in plowing are: (a) In the case of moldboard plows the moldboard should be in good scouring condition and adapted to the character of the soil and its moisture condition; (b) the speed of the plowing should be that at which experiment on the ground indicates that the best results as to pulverization are obtained; (c) the depth of plowing should be as great as consistent with other important considerations in the aggregate, since within limits increased depth of plowing means increased pulverization of the soil; (d) the soil should be neither too dry nor too wet at the time of plowing. If it is too dry the furrow slice breaks up into large lumps or clods. If it is too wet it breaks up very little or not at all. The range of proper moisture conditions for a light or sandy soil is of course much greater than for a heavy or clayey soil.

2. The accomplishment, in the highest practicable degree, of the turning under of whatever weeds or trash there may be on the ground at the time that it is plowed.

The efficiency of a plow in turning under weeds and trash is affected by each of the following considerations, and each one of them should be regulated to the best effect consistent with other important considerations in the aggregate: (a) Speed of plowing; (b) depth of plowing; (c) use of special devices or attachments, such as chains, coulters, jointers, etc.; (d) the soil should be neither too dry nor too wet at the time of plowing. If it is too dry the breaking up into large clods which do not turn over completely or in regular order permits the weeds and trash to protrude above the surface of the plowed ground. If it is too wet the vitality of turned-over weeds is such that they are able to take advantage of such openings as may be left to continue their growth.

In case of very hard or dry soils the disk plow accomplishes both the pulverization of the soil and the turning under of weeds and trash in higher degree than the moldboard plow. The setting of the scrapers on disk plows governs largely the turning of the furrow and the burying of trash. Ordinarily the requirements of the specifications as to a flat furrow bottom can be met by setting the disks so that each cuts a width of about eight inches.

Crowning and flattening are opposing terms. In general, crowning will be used for ground which is to be cropped the next season and flattening for ground which is to be cropped the same season. In flattening the attempt is made to leave the surface of the plowed ground uniform, with no lines to distinguish the furrows. In crowning the attempt is made to turn the furrow so that the slice does not fall flat but stands upturned at an angle of about———degrees from the horizontal.

At various points in the accompanying specifications it is indicated that the manager may direct plowing to be done otherwise than as there specified. Not all of such exceptions

can be anticipated and noted in advance. It was for this reason that the specifications have been left at these points in what may seem an indefinite form. The general and best practice, however, points clearly to certain of such exceptions. For instance, it will not, of course, be required that a sod mat be pulverized in plowing. It is also true that the earth is turned over with little or no pulverizing in those instances in which the furrow is required to act in some measure as an underdrain, and where the ground is so wet that it is necessary to give the top of the furrow slice an opportunity to dry so that it can be tilled successfully. It is also well known that a certain degree of the crowning of the furrow, forbidden by the specifications, is desirable in the case of fall plowing for spring cropping.

"A wet soil should be plowed more shallow, other things being equal, than a dry soil because the puddling action is less. On a dry soil the depth should be increased in order to increase the pulverization. Combining these principles then it may be said that if a clay soil must be plowed when too wet it should be plowed with a sod plow and to as shallow a depth as is permissible. But on an over-dry soil the opposite conditions should be fulfilled, that is, the use of a steep moldboard and to an increased depth. Likewise, on a sandy soil, where the aim is generally to compact the structure, this may be furthered by deep plowing with a steep moldboard when the land is over-wet. (Lyon, Fippin, Buckman-"Soils, Their Properties and Management," page 670.)

"Furrows on rolling land to run as nearly as practicable with contours in order to avoid washing and, in case of fall plowing to hold moisture which falls. Fall plowing of heavy or clay lands more advantageous than in case of light or sandy soils. Spring plowing to be as early as frost and moisture conditions will permit on account of the much greater loss of soil moisture from the unplowed ground," page 189. "There was another very serious result which followed this delay in plowing, for there were developed in the unplowed ground, as a consequence of the rapid loss of water from the soil, great numbers of very large and very hard clods. So that, instead of having this piece of land in excellent tilth with plowing and once harrowing, it became necessary to go over the ground twice with a loaded harrow, and twice with a heavy roller, before it was brought into a condition of tilth even approximating what it might have had had it been plowed seven days earlier." (King, "The Soil," page 187.)

"Efficient tillage requires an understanding of the properties of the soil, good practical judgment as to its condition, facility in the selection of the proper implements for its modification, and mechanical skill in their operation. The same result may often be attained in different ways, and the practical necessity that frequently arises for the farmer to get on with a relatively few tillage implements where a variety of soil conditions must be dealt with draws heavily on his resourcefulness." (Lyon, Fippin, Buckman—"Soils, Their Properties and Management," page 681.)

SPECIFICATIONS FOR PLOWING

1. PULVERIZATION OF THE SOIL. Except as may be designated in writing in special cases by the manager, plowing shall be done in such a manner and with such implements as to accomplish a thorough breaking up and pulverization of the furrow slice from top to bottom, without the formation of large clods. An unbroken furrow slice or one which breaks up into large lumps or clods will not be permitted.

2. COVERING TRASH, ETC. Trash, growing plants, manure, or other matter on the surface of the unplowed field shall be turned completely under, and shall not show on the surface of the plowed field.

3. AIR SPACES. No air spaces will be permitted in or beneath the furrow slices, unless otherwise ordered in writing by the manager.

4. CHARACTER AND UNIFORMITY OF FURROWS. The top lines of the furrows must be uniform, without breaks or depressions. The top of the furrow may be only slightly ridged, unless otherwise ordered in writing by the manager. Furrows must be uniform compared with one another. The depth of all furrows must be the same, and continue a uniform depth. The bottom of the furrow shall incline slightly upward transversely from the landside, but this inclination shall in no case amount to more than one-fourth of an inch in the width of the furrow. The furrow shall be clean cut in every part. Furrows must be kept straight, or at least parallel to the initial furrow of the land. No unnecessary curves shall be in-

"Trash, growing plants, manure, or other matter on the surface shall be turned completely under"

troduced in the initial furrow of a land. Cut-and-cover, which results when there is an uncut strip between one furrow and the next, as when it is undertaken to plow a fourteen-inch furrow with a twelve-inch plow, will not be permitted. Dead furrows must not only be free from unturned ground, but the plowing from the two sides should lap instead of barely meeting, to the end that the depth and width of the dead furrow may be reduced as much as practicable. Back furrows shall be turned to leave a neat center not higher than the rest of the field.

5. Depth of Plowing. Depth of plowing, which shall be understood to mean the depth of the bottom of the furrow, on its center line, below the surface of the adjacent unplowed ground, shall be——inches, unless otherwise prescribed by the manager. In case it becomes necessary, at any point, to measure the depth of plowing in the plowed ground instead of in an open furrow, the average depth of the plowed ground over an area of sixteen square feet shall be ascertained, and the depth for plowing shall be taken as——— per cent of this average depth for settled plowing and——— per cent of this average depth for plowing which has not settled.

6. Limiting Features, Regularity of Lands and Boundaries. The minimum width of lands may be prescribed by the manager. Except in cases where it is manifestly impracticable to do so lands shall be laid out in rectangular form. Where such rectangular form is impracticable the lands shall be laid out in such form as to result in the least possible irregularities in the closing of said lands. Where the extreme boundaries of the fields or tracts to be plowed are marked by fences, hedges, rows of trees, ditch banks, or other limiting features, the plowing shall extend as nearly as possible to said extreme boundaries. In no event shall the width of the unplowed strip adjacent to the fence or other limiting feature exceed three feet for horse-drawn plows or eight feet for plows drawn by the largest tractors. Ends of furrows shall be in a regular line parallel to the limiting feature which constitutes the adjacent end boundary of the tract or field.

7. Tractor Operation. The right is reserved to the manager to direct the laying out of lands for tractor plowing, and the laying out of lands in all such cases shall conform strictly to such directions. Tractors will not be permitted to turn on or travel over plowed ground except in case of unavoidable necessity.

8. Disk Plowing. When ground is or becomes too dry to be plowed successfully with a moldboard plow the disk plow shall be used. The disk plow may be used also in soils in which the moldboard plow will not scour, and in gravelly soil where a moldboard plow will not work. The disk plowing shall be done in such a manner as to obtain practically the same results as to pulverization of the soil and covering of trash as have been herein specified for moldboard plowing. The disks shall be set near enough together to insure a practically flat furrow bottom. A deeply dished furrow bottom will not be permitted.

9. Plowing Required. Unless otherwise directed by the manager, plowing in conformity with the foregoing specifications will be required as a part of the preparation of the seedbed on all fields.

10. Standard. The plowing on any area one-half acre or more in extent, upon which——per cent or more of the plowing fails to conform to the foregoing specifications, will not be paid for.

Specifications—Tillage Subsequent to Plowing

11. General Features of Seedbed. Tillage subsequent to plowing shall be directed to the following ends: (a) The seedbed shall be mellow and free from clods. A granular structure, as distinguished from one that is either powdery or cloddy, shall be obtained; (b) the seedbed shall be made firm, the granular particles of the soil being brought into

"Plowing shall be done in such a manner as to break up and pulverize the furrow slice"

close contact with each other, and the furrow slice being pressed against the unstirred ground beneath it so as to form a compact union which will insure an effective capillary connection for the rise of soil moisture from below into the seedbed.

12. Harrowing. Harrowing shall follow immediately or within a few hours after plowing ground which is to be cropped the same season. On fields of such size that the plowing is wholly accomplished in one day or less, they shall be cross-harrowed at once.

12a. Double Harrowing. When double-harrowing is required in order to obtain the character of seedbed herein specified the second harrowing shall in all cases be accomplished by cross harrowing, the term cross-harrowing being understood to mean harrowing across the plow furrows.

13. Set of Harrow Teeth. When the chief object of the harrowing is to tear up the ground the teeth shall be set straight. When the chief object of the harrowing is to smooth the ground the teeth shall be set slanting.

14. Disking Purposes. Disking subsequent to plowing shall be employed for the following purposes: (a) To break up a hard crust when the peg-tooth harrow is not adequate to the purpose; (b) to form a compact union between the upper and lower layers of the seedbed; (c) to cut up turned-over sod; (d) to kill weeds; (e) to fill dead furrows and reduce ridges; and (f) other purposes as directed by the manager.

15. Set of Disks. To break up a hard crust, the disks shall be set at an angle to cut to a good depth. To form a compact union between the upper and lower layers of the seedbed the disks shall be set nearly straight and weighted to cut to a good depth. To cut up, turn-over sod, the disks shall be set at an angle to cut to a depth of about one-half inch below the breaking. To kill weeds the disks shall be set at an angle to cut a depth corresponding to the size of the weeds and the depth of their roots. To accomplish two or more of the fore-

going objects at the same time, the disks shall be set, or set and weighted, for the best combined effect. Ridges and back furrows shall be levelled by driving once down and back with the center of the disk on the ridge or back furrow.

16. Double Disking. On fields which are to be irrigated (except where the firming of the soil is the sole object of the disking) double disking exclusively shall be used. The tandem disk, with the disks staggered, shall be used preferably in all double disking.

17. Floating. All fields which are to be irrigated shall be floated. The floating shall be done as the last operation before seeding, unless rains intervene. The floating shall be done with such implements and in such manner as to bring the loose soil of the field into a uniform surface suitable for irrigation.

Specifications for Preparing Lands for Cultivation

18. Clearing Arid Lands. The price bid for clearing arid lands shall include breaking or cutting off or pulling out, and burning or removing completely from the land to be cleared all sage brush and other refractory growths whose presence on the ground would interfere with the cultivation and cropping of the land.

19. Leveling Fields for Irrigation. On all fields which are to be irrigated, Fresnos or other suitable implements shall be employed to level down all humps and fill all depressions, so as to bring the field into one regular smooth surface suitable for cultivation for irrigation, provided that this work of leveling shall not be taken to mean the filling up of natural drainage channels. The filling of natural drainage channels when required to be done shall be done in accordance with the specifications to be furnished by the manager for the particular case.

Specifications for Preparation of Seedbed Without Plowing

20. Disking. By permission or direction of the manager double disking may be substituted for plowing as the first tillage operation in preparing the seedbed. On land which has been previously cultivated the disk shall be drawn squarely or diagonally, as may be directed by the manager, across the rows or furrows of the tillage of the preceding season.

21. Harrowing. Harrowing shall follow disking in all cases where necessary or required in order to produce a mellow seedbed of granulated texture.

The following specifications were drawn with particular reference to operations consisting of making permanent improvements and forming farming operations on and the marketing and sale of crops grown upon lands situated in the First Owsley Project in Jefferson County, Idaho, which consists of the following items:

1. Clear the entire area of each of the tracts of land to which this contract refers, except such areas as may be already cleared and excepting also such areas as may be occupied to the exclusion of such clearing.

2. Level down the lumps and sand ridges and fill the depressions on such tracts. Provided, that the charge for such levelling and filling shall not amount to more than $3 per acre on any particular tract in any one calendar year without the written permission of the first party.

3. Prepare in the proper season of each year and in full conformity with these specifications a suitable seedbed for the sowing and planting of crops on the entire area of each particular tract of land referred to in this contract, excepting insofar as such area may be occupied to the exclusion of cropping.

4. Sow and plant each year in proper season on the entire area of each particular tract of land referred to in this contract such crop or crops as may be designated by first party for each such tract respectively, except insofar as such area may be occupied to the exclusion of cropping, it being understood that the entire area of each such tract shall as soon as practicable be seeded to alfalfa, and that when a stand of alfalfa is obtained it shall be considered as occupying the land to the exclusion of cropping.

5. Cultivate in proper manner and in proper season all growing crops which require such cultivation.

6. Irrigate, harvest, care for, and market all crops grown on the lands referred to in this contract.

7. Construct, in full conformity with these specifications, all dikes herein required to be constructed.

8. Construct, in full conformity with these specifications, all fences necessary to protect crops growing or grown upon lands referred to in this contract, as may be directed by first party.

9. Construct such other permanent improvements, except irrigation ditches and laterals, in addition to those hereinbefore noted, as may be directed from time to time by first party.

10. Keep complete and accurate accounts, covering especially all work done at an hourly rate and all materials furnished on each particular tract of land, and all items which cannot be subsequently properly measured or appraised on the ground. Furnish invoices covering all freight bills and purchases of material including seed, also sales, said accounts and invoices to be subject to inspection at all times by first party or its representative.

Specifications for Various Operations

Irrigation. Irrigation shall be so conducted as to apply the water evenly over the tracts irrigated so as to prevent washing of the soil and the amount of water applied at any time shall be comformable to the needs and within the tolerance of the crops irrigated. The time of irrigating and the number of irrigations shall be determined by the needs of the crops irrigated, according to the best local practice. Consideration shall be given also to avoidance of an undue amount of moisture in the soil at times when the fields must be entered upon for tillage or harvesting operations.

Dikes. Dikes shall be so constructed that when settled they shall have a base width of six feet and shall crown not less than ten inches above the surface of the field. Unless otherwise directed by the first party, the interval between dikes shall be eight rods.

Seeding. Seeding shall be done either by drilling or broadcasting, and shall be done by experienced and reliable men only. In deciding upon the method and depth of seeding and the amount of seed used, due account shall be taken of the crop to be grown, whether it is to serve as cover crop. the condition of the soil, and the time of seeding. Drills and broadcaster shall be calibrated by measuring off an acre of land, seeding same, and noting precisely the amount of seed used. No requisite or manifestly advantageous seed treatment shall be omitted.

Treatment of Seed for Smut, Stinking Smut, Loose Smut of Wheat and Oats. Formalin: One pound Formalin (forty per cent solution of formaldehyde) to fifty gallons of water. Spread seed over floor and sprinkle with solution and cover with bags and leave over night; then shovel over and allow to dry, or immerse in solution for several minutes and allow to dry slowly.

Blue Stone (or copper sulphate): One pound of copper sulphate to five gallons of water. Immerse seed for several minutes in solution, allow to stand in bag for several minutes to drain, then spread and dry. Or seed may be sprinkled at the rate of one gallon of the solution to four bushels of the grain, sprinkling and stirring until thoroughly wet; after about an hour spread and dry.

Oats Cut for Seed. Oats shall be cut when about half of the leaves are still green and the seed in the dough stage. In such case the shocks shall be set to permit slow curing and

ripening. When rapid curing is desired cutting should be done when the seed is in the hard dough stage. Oats shall not be permitted to stand uncut after the seed is ripe, to prevent scattering of seed. General specifications for stacking bound grain shall apply to the handling of oats.

Oats Cut for Hay. Oats shall be cut for hay while the seed is in the milk stage. It may be cut with a mowing machine, raked and stacked, or it may be cut with a binder and shocked in small round or oblong shocks and stacked when properly cured. Specifications for stacking hay shall be applied in this case.

Wheat Cutting With Binder. Cutting shall begin as soon as bottom of straw is dead and begins to turn yellow. The grain shall be in the dough. The kernel should be soft enough to be indented easily with the thumb nail, and hard enough not to be easily crushed between the fingers. Wheat should not be allowed to stand in the field after it is dead ripe.

Cutting With Header. Cutting with a header shall begin when the straw is ripe and the seed in the tough-dough stage. It shall be stacked in ricks. When bottom is started the sides shall be built straight up to the proper height instead of slanting to the middle. The middle must be kept full and higher than the sides and well tramped all the time. The stacks shall be finished by drawing in at the top and capping properly, the aim being to construct a symmetrical, waterproof top. The conformation of the stack shall be symmetrical.

Shocking Bound Grain. Shocks shall in general be made as nearly circular as practicable. When the straw is too green for proper curing in circular shocks they shall be made in elongated form with the long dimension running north and south. Shocks shall be capped with one or two sheaves, as may be necessary for the protection of the heads of the grain from exposure to rain and dew. Care shall be taken to make the sheaves stand firmly on the ground, and the heads shall be pressed firmly together. Shocks shall be set on top of land ridges where available, and none shall be set in sheltered or shady places or in depressions.

Stacking Bound Grain. Bound grain shall be stacked as soon as no uncured straw or weeds, or excess of moisture from rain or dew, is apparent. In beginning the stack sheaves shall be set up in the middle with heads upward, the sheaves next to them being similarly placed except that as their position approaches the outside of the stack they are inclined more and more to the vertical, so as to start the stack with a high center.

Inoculation of Alfalfa Seed. Alfalfa seed shall be treated according to instructions given with each certain kind of culture to be used.

Alfalfa Cutting. Alfalfa shall be cut when the next crop begins to grow at the crown, and before it gets up to the size where it would be clipped by mowing. Cutting shall be delayed after heavy rain to allow ground to take up excess moisture so that it will not operate against proper curing. Alfalfa shall not be cut while wet with rain or dew.

Alfalfa Raking. The rake (side delivery preferred) shall follow about two or three hours after cutting or just as soon as alfalfa is wilted and all excess moisture off.

Alfalfa Curing. Curing hay shall take place partly in the swath, in the windrow, in the stack, and in the mow. Handle as little as possible. Protect against rain or dew. Hay shall be raked into light windrows and allowed to cure for several hours. Then the hay shall be put into small cocks and there allowed to cure slowly so as to preserve the natural color. The cocks shall not be left on the ground more than three days without moving them to keep from smothering the plants under them.

Alfalfa Stacking. Alfalfa shall not be stacked while wet with dew or when water can be wrung out of the stems. The natural color of the hay shall be preserved as much as possible. Alfalfa shall be stacked in long ricks. When bottom is started the sides shall be built straight up to the proper height instead of slanting to the middle. The middle must be kept full and higher than the sides and well tramped all the time. The stack shall be finished by drawing in at the top and capping with green hay or other more compact material, the aim being to construct a symmetrical waterproof top. The conformation of the stack shall be symmetrical.

Alfalfa Cutting for Seed. Length of season permitting, the second or third crop, or even a later crop shall be left and cut for seed. Cutting shall be done when the greater proportion of seeds are hard, but not sufficiently ripe to shell. Pods at this time will be dark brown in color. The cutting shall be raked into windrows within two or three hours after cutting and in a few hours more put into cocks and let stand for a day or two until well cured and dry before stacking. Seed shall not be stacked when damp or wet with dew.

Fencing. Post holes shall be dug twenty feet apart and in a perfect line, and shall be not less than twenty-four inches deep, except in case of corner or gate post, which must be not less than thirty inches deep and shall be large enough to permit the receiving of post and permit proper tamping in of loose dirt. For intermediate or line posts where solid rock is encountered, not more than two adjacent posts shall be set on sills. (Detail of sill: A 4-by-6 four feet long is laid on the surface; to this toe-nail post in center of bottom sill and brace with two pieces of 2-by-4 thirty-two inches long and weight down with rock.) Posts shall be set in a perfect line on the side on which the wire is to be strung and shall be set straight up and down, and the dirt shall be firmly tamped so as to permit the post to remain solid in the ground. Corner or gate, or end panels of fence shall be properly and firmly set and anchored so that they will not give or lift up in stretching or tightening of the wire. To anchor corner, gate, or end post, set same, then set another post six and a half or seven feet away and fasten pole from top of corner to top of second post. Then dig place for "dead-man" on the outer side of corner or end panel or inside of gate in such manner that when double wire is put on from top of second post to "dead-man" wire will enter the ground just outside of the corner or end panel, or inside of the gate so as not to protrude out. "Dead-man" shall be set firmly and double wire twisted to take up all slack and make firm to panel. In crossing depressions it will be necessary to nail securely to the bottom of the post a short cross piece which, when buried, will prevent post from pulling up. In crossing deep gullies or deep ravines the wire shall be weighted down with a well fastened rock or in a dry ravine a "dead-man" shall be buried and wires tied to same.

Wire shall be stretched uniformly and tight. Each succeeding wire shall be parallel to the other, wire to be placed on the side of post away from the field. All joints and end ties to be made well and neatly, all excess ends to be neatly wrapped or trimmed off. Stays to be set in the center between posts. Stays to be steel wire, or light wood stay properly fastened to permit proper spacing of wires. Wire in three-wire fence to be spaced as follows: Top, fifty inches from the ground; middle, thirty-four inches from the ground and lower or bottom twenty-two inches from the ground. Staples shall be one and one-half inches long, set diagonal with the grain of the wood, and driven home tight on end corner, and gate posts, the top wire to be double stapled. Gates to be made wherever necessary to get into field or yard and to be of "Wyoming" or wire type.

How Explosives Help Develop Waste Land

By **Arthur W. Wilson**

Manager, Agricultural Department, Hercules Powder Company, Wilmington, Delaware

THE United States Department of Agriculture estimates that there are about two hundred million acres of forest, cutover, and woodland in the United States, including that in farms, which can be cleared and put into crops. This acreage constitutes about one-tenth of the total land in the country. The largest cutover areas are situated in the northern sections of Michigan, Wisconsin, and Minnesota, in the Pacific Northwest, and in the South.

The next great area of land which can be put under cultivation is the swamp and periodically overflowed land. Of this area there are some sixty million acres which will be suitable for farming after draining. The major portion lies in the Mississippi Valley region, throughout the Coastal Plain of the South, and includes the muck lands and peat bogs in the glaciated regions of Minnesota, Wisconsin, and Michigan.

The next field awaiting development is found in vast areas of land in the Western states which is classified as "potentially irrigable." It is estimated that thirty million acres of it would be available if all sources of water supply were fully utilized.

The fourth class is land which our census defines as unimproved land other than woodland. Some fifty million acres of it are composed of stony pastures in hilly regions, and in unused fields, and parcels of waste tracts. It is located principally in our eastern and northeastern states. Combined with land suitable for dry farming, this area totals some eighty million acres.

Summarizing, we find that the potentially arable acreage in the United States is as follows:

Woodland (suitable for crops)	200,000,000 acres
Drainable, now in forest, grass, etc.	60,000,000 acres
Irrigable	30,000,000 acres
Upland pasture and dry farming	80,000,000 acres
	370,000,000 acres

These undevoloped lands if divided into tracts of one hundred acres each would provide 3,700,000 farms, or over one-half of the number now in existence in this country.

In this discussion, however, we shall not concern ourselves with the economic aspects of the development of this potentially arable land. The proportion which should be devoted to forest lands, crops, and grazing is a problem for the economist. Nor shall we discuss this problem from the standpoint of the sociologist who considers what it will mean to the nation to provide tillable land for so many new farms and homes. We shall merely look into the engineering methods employed at present to prepare these undeveloped wastes for the plow, and consider some of the factors with which the agricultural engineer, the professor of agricultural engineering, the college student, and the manufacturer of farming machinery or equipment should be familiar.

In the cutover areas of the Great Lakes states, remarkable progress has been made during the last few years in the methods employed in clearing land. Stumps are usually removed by one of three ways—by mechanical means, by explosives, or by a combination of both. Under mechanical means we classify methods of removal by ordinary block and tackle, by stump pullers (hand and horsepower), tractors, donkey engines, or especially designed machinery.

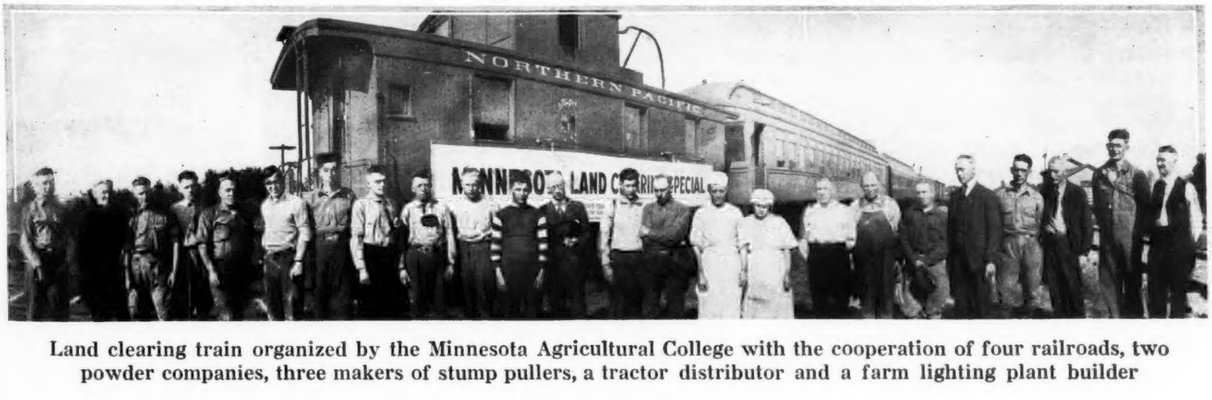
We find that explosives are used in increasing quantities each year in the cutover areas. The state of Wisconsin alone, according to estimates, will probably use between three million and four million pounds this year.

In removing stumps explosives are employed either alone or in combination with a mechanical device. When a stump is removed by a puller or tractor, a large amount of earth usually remains between and on the roots which renders handling and burning extremely difficult. However, if a small charge of dynamite is used before removal, the earth is blown from the roots, pulling is easier, and the stump is cracked so that handling and burning are facilitated. Another practice is to pull the stump first and then dynamite the crown by "mudcapping" to break the stump and roots and do away with the earth.

The agricultural engineer is frequently asked the question: "Shall I clear land with dynamite or stump puller?" Perhaps the combined use of both may be the cheapest and most efficient way. All three methods have their advantages and disadvantages.

To many settlers with limited capital who cannot afford to buy land-clearing machinery, dynamite offers an advantage in that small quantities can be bought as required. A few hundred pounds cost but little compared with powerful land-clearing machinery and the settler is thus able to clear and cultivate tracts year by year and gradually "get ahead."

Without doubt the development in organized land clear-



Land clearing train organized by the Minnesota Agricultural College with the cooperation of four railroads, two powder companies, three makers of stump pullers, a tractor distributor and a farm lighting plant builder

Ditches blasted with 60 per cent straight nitroglycerine dynamite. In the two upper ditches there was a single row of holes with one stick of explosive in each hole. The absence of spoil banks will be noted

ing has reached a higher plane in Wisconsin and Minnesota than in any other part of our country. For some years the manufacturers of explosives, land-clearing machinery, the railroads, and the state colleges of agriculture have cooperated in running "land clearing specials" through these states. The one in Minnesota last year was unusually successful. During a period of six weeks a train of nine cars traveled over a thousand miles through Minnesota's cutover area. Twenty-six field demonstrations were held before some twelve thousand farmers. Each demonstration was well advertised in advance and commercial and farm organizations cooperated splendidly with the representatives of the train.

During these demonstrations the proper and most economical uses of explosives were shown, both separately and in combination with stump pullers and tractors. At each field where the demonstrator worked from three to five acres of stump land were completely cleared. The stumps were piled by a Conrath piler and made ready for burning. Demonstrations showing the use of dynamite for ditch blasting also attracted much attention. Another interesting phase was a large breaking plow drawn by a tractor which broke the virgin land. It was highly effective in rolling out small boulders and the roots of stumps and brush.

Evening meetings were held at which representatives from the extension division of the university, members of the department of rural engineering, representatives of the railroads, and manufacturers of explosives and machinery spoke to the land owners and farmers, many of whom had come a considerable distance.

It has been estimated that these trains have saved the settlers thousands of dollars by showing them that low-percentage explosives will remove stumps as effectively and much more economically than the higher percentage dynamites which they had used formerly. In the cutover areas of the Great Lakes states, a twenty per cent low-freezing ammonium nitrate (extra) dynamite is the most economical and satisfactory explosive to use for stump blasting. This grade is cheaper than the higher percentage dynamites, and it has a better "heaving" and "lifting" power. It can be handled with less likelihood of accident than can many of the other dynamites on the market.

Another important step taken by Wisconsin and Minnesota has been the appointment of a state land-clearing supervisor to stimulate interest, coordinate the work, and to spread information concerning the best and most economical methods of developing the cutover areas.

In several counties land-clearing associations have been organized by farmers, lumber companies, bankers, and business men. A paid secretary, who is frequently a graduate of the state agricultural college, is placed in charge as supervisor. The county agent cooperates closely with him in organizing meetings, holding demonstrations, and arranging for the purchase of explosives in carload quantities. In one county in Wisconsin in which such an organization was formed 18,000 acres were cleared in a single year. In some counties prizes have been awarded to the farmer who brushed and cleared the largest acreage and made it ready for the plow.

Manufacturers of explosives have cooperated with these associations by holding demonstrations and sending instructors to land-clearing schools, which have been attended by large numbers of people who are eager to get practical experience in the best ways of removing stumps.

Distillation of stumps is a comparatively recent and important factor in the development of land clearing. Particularly in the South, which has a vast area covered with stumps of the long-leaf pine, has this operation been studied carefully.

By distillation of long-leaf pine stumps mixed tar oils are obtained from which turpentine is redistilled. Flotation oils, pyroligneous acid, and charcoal are other products obtained from this process. Numerous small or medium-sized distillation plants are being operated by land and lumber companies. In other sections of the country also distillation of stumps is being carried out on a commercial basis and the sale of the products helps offset the cost of clearing many acres of land covered with stumps.

Many studies have been made by agricultural engineers of the various agricultural colleges and experiment stations in the cost of clearing an acre of land. So many different factors enter into this problem that after the data has been compiled it has been of little use except in the immediate vicinity in which the experiment was conducted. The number of stumps to the acre, the kind, size and type of the stumps, and

the time since the trees were cut, the character of the soil, the efficiency of the labor, and the cost of labor and explosives are all important considerations. To make any general statement about the cost of clearing land would be of little value.

A good field awaits the man or organization who will clear land on a contract basis. There is a growing demand for competent executives who can handle men, explosives, and land-clearing machinery. The training of such men offers a great opportunity to the agricultural engineering departments of state agricultural colleges.

In several sections of the country, and in the Mississippi delta in particular, drainage work is carried on in a highly organized manner.

For years the Mississippi river has periodically overflowed its banks and deposited tons of rich alluvial soil a distance of some miles back of its banks. The richness of the soil of the "Alluvial Empire" of Mississippi, Arkansas, southeast Missouri, and Louisiana is said to compare equally with that of the Nile delta. Until the government put high and strong levees along the Mississippi this land could not be occupied safely nor could it be drained satisfactorily.

In various parts of this region, drainage districts have

At the left, a large white pine stump completely removed and split by 9½ pounds of electrically fired dynamite. At the right, a side view of a blast which made a ditch four hundred feet long

DITCH BLASTING COSTS*

Location	Date	Method	Dynamite	Soil	Length Feet	Avg. Width Feet	Depth Feet	Cubic Yards Blasted	Number Man Hours	Labor Cost	Explo. Cost	Total Cost	Cost Per Cu. Yard	Lbs. Dynamite Per Cubic Yard	Lbs. Dynamite Per Linear Foot
Hartselle, Ala.	2-23-20	Electrical	60% L.F.N.G.	Moist Loam	871	5½	4	709.7	21	$4.20	$128.41	$132.61	.187	.613	.499
Osceola, Ark.	3- 2-20	Propagated	60% N.G.	Wet Gumbo	300	5	4	222.2	20	9.00	41.40	50.40	.226	.81	.600
Washington, Ark.	4-28-20	Propagated	60% N.G.	Moist Gumbo	600	4	3	266.6	28	10.60	58.75	69.35	.260	.842	.374
Portland, Ark.	5-8, 9, 10-20	Propagated	60% N.G.	Wet Clay	6100	4½	4	4066.6	160	50.00	776.21	826.21	.203	.71	.473
Marianna, Ark.	5-13 to 20-20	Propagated	60% N.G.	Wet Clay	4525	8⅚	4⅙	6168.0	232½	131.35	1204.65	1336.00	.216	.729	.993
Louise Ark.	5-27-20	Electrical	60% N.G.	Moist Gumbo	300	5	3	166.6	12	2.40	51.98	54.38	.326	.9	.500
Swifton Ark.	6-22-20	Propagated	60% N.G.	Wet Gumbo	1050	4	3	466.6	15	8.00	100.10	108.10	.231	.75	.333
Sarasota Fla.	5- 4-20	Electrical	40% N.G.	Muck	506	8	4	599.7	36	12.60	93.65	106.25	.178	.665	.788
Collinsville, Ill.	4- 7-20	Propagated	50% N.G.	Wet Loam	660	6	3	440.0	48	17.60	158.00	175.60	.399	1.363	.908
Mitchell, Ill.	4-28-20	Propagated	60% N.G.	Moist Loam	80	4½	3	40.0	4	1.80	7.60	9.40	.235	.625	.312
Sycamore, La.	9-16, 17-19	Electrical	40% L.F.N.G.	Moist Gumbo	47	8	2	27.8	3	.60	10.00	10.60	.381	1.149	.680
Erath, La.	3-24-20	Propagated	60% N.G.	Wet Clay	825	6	5	916.6	54	8.10	126.81	134.91	.147	.6	.666
Pope, Miss.	2- 4-20	Electrical	40% L.F.N.G.	Moist Gumbo	81	5	3	45.0	2	.40	8.69	9.09	.202	.877	.487
Pheba, Miss.	3-23-20	Electrical	40% Extra L.F.	Wet Clay	450	4½	4	200.0	18	4.50	70.18	74.68	.248	.708	.472
Gunnison, Miss.	3-25-20	Electrical	60% N.G.	Wet Gumbo	380	10	5	703.7	20	6.00	94.78	100.78	.143	532	.985
Merigold, Miss.	4-30-20	Propagated	60% N.G.	Wet Gumbo	900	2	2	133.3	36	7.20	57.22	64.42	.483	1.35	.200
Gunnison, Miss.	6-26-20	Propagated	60% N.G.	Wet Gumbo	5280	4	3	2346.6	80	16.00	475.42	491.42	.209	.75	.333
Marquand, Mo.	11-19-19	Propagated	60% N.G.	Wet Muck	575	5	3½	372.6	22	6.60	50.40	57.00	.153	.506	.327
Canalou, Mo.	3-18-20	Propagated	60% N.G.	Wet Muck	2200	4¾	2½	967.5	109	67.25	213.35	280.60	.290	.825	.362
Morehouse, Mo.	3-31-20	Propagated	60% N.G.	Wet Gumbo	2100	3	3	700.0	81	23.00	167.00	190.00	.271	.892	.297
Henrietta, Mo.	4-12-20	Propagated	60% N.G.	Wet Clay	175	6½	3	126.3	6	3.80	29.00	32.80	.259	.781	.562
Blodgett, Mo.	4-20-20	Propagated	60% N.G. & 40% E.L.F.	Wet Gumbo	825	10	4¾	1451.3	30	18.00	186.85	204.85	.141	.62	1.090
Sikeston, Mo.	5-20-20	Propagated	60% N.G.	Wet Gumbo	1320	4	3½	684.4	30	10.40	105.00	115.40	.168	.642	.332
Caldwell, N. J.	7- 7-19	Electrical	60% N.G.	Hard Clay	30	8	2	17.7	7	2.80	5.12	7.92	.447	1.111	.658
Budd's Lake, N. J.	3- 6-20	Propagated	60% L.F. Ex.	Wet Loam	12	5½	3	7.3	1	.80	1.35	2.15	.294	.684	.418
Caldwell, N. J.	4-30-20	Propagated	60% L.F.N.G.	Wet Clay	32	5½	3	19.5	2	1.20	2.70	3.90	.200	.511	.312
Bloomsburg, Pa.	6- 6-19	Electrical	50% Extra L.F.	Clay & Gravel	335	6	4	297.7	75	18.75	78.08	96.83	.325	1.007	.895
Woodstock, Tenn.	12-30-19	Electrical	40% Extra L.F.	Silt & Clay	275	5	3½	178.2	12	6.40	45.05	51.45	.288	.981	.635
Humboldt, Tenn.	1-27-20	Electrical	40% L.F.N.G.	Wet Clay	200	5½	3½	142.5	12	3.60	31.66	35.26	.247	.784	.558
Rosser, Tenn.	2-19-20	Electrical	40% Extra L.F.	Moist Loam	300	5	3½	194.4		(No Charge)	40.41	40.41	.207	.751	.486
Brunswick, Tenn.	3- 9-20	Electrical	40% Extra L.F.	Wet Clay	175	6¾	4	175.0	12	2.40	42.20	44.60	.254	.902	.902
Woodstock, Tenn.	3-15-20	Electrical	40% Extra L.F.	Wet Muck	60	6	4	53.3	5	1.50	10.42	11.92	.223	.703	.624
Brunswick, Tenn.	5-14-20	Electrical	40% Extra L.F.	Moist Clay	360	4	3	160.0	12	3.60	39.84	43.44	.271	.75	.333
Coupland, Tex.	2-14-20	Propagated	60% N.G.	Wet Gumbo	1950	4¼	4	1300.0	80	24.00	334.48	358.48	.275	.977	.615
Irving, Tex.	6- 9-20	Propagated	60% N.G.	Wet Muck	120	5	3½	77.7	3	.90	12.10	13.00	.167	514	.333
Average 35 ditches.						5.5	3 4						.25	797+	

*Compiled by the Agricultural Department of the Hercules Powder Company

been organized, surveys made by engineers, and financing has been accomplished by the sale of bonds and the levying of taxes. Large main canals are dug by powerful dredges of various types. Here again dynamite is used in removing large stumps and clearing the right-of-way ahead of the dredges.

After the main canals have been put through, the problem of digging lateral open ditches about three feet deep and six feet wide remains for the individual landowner. These must be dug through swampy land in which it is very difficult for men and teams to work. As the use of dynamite for this purpose is not yet generally known we shall outline briefly the methods employed.

Two methods of blasting ditches are used: the propagated and the electric. Briefly, the method employed for shooting a propagated ditch is to punch a row of holes about eighteen inches apart, place a high percentage, usually sixty per cent, straight nitroglycerine dynamite in each hole, prime one charge and shoot it by the electric or the cap-and-fuse method. The detonation of the primed charge is transmitted to the charges on each side, which in turn detonate others. The whole row of charges is shot in an instant, and earth, water, snags, or stumps in the course of the ditch are thrown high into the air and fall at a distance along the sides of the ditch.

A propagated ditch blast is successful only in thoroughly watersoaked soil, the temperature of which is warmer than fifty degrees Fahrenheit. If the temperature runs much below this point the cartridges become insenitive and fail to shoot.

The electric method is usually the more expensive of the two and involves the use of electric blasting caps, a leading wire, and a generator, preferably a No. 3 blasting machine, all of which are sold by manufacturers of explosives. This operation is used mainly in dry soil (as when cutting off a bend of a stream) or when the temperature is too cold for propagated shooting. Low-freezing dynamites, which do not freeze until water freezes, are frequently employed when shooting with the electric method. Holes are punched about three feet apart, and an electric blasting cap is placed in the upper cartridge in each hole. The wires from the electric blasting caps are next connected in series and then to the leading wire which runs to the generator.

The accompanying table shows the results of blasting ditches in ten states which was compiled by the agricultural service men of the company with which I am associated. The figures in it are for materials and labor based on 1920 prices, and the same work could undoubtedly be done today at less money. This table brings out the fact that on an average .79 pounds of dynamite will remove a cubic yard of earth. Hence, if you estimate the number of cubic yards of earth to be removed in a ditch, and divide by this factor (or by 1 as a safer factor) you can estimate the number of pounds of dynamite needed for the work.

Up to the present time few experiments have been made and little data has been collected by agricultural engineers or the various agricultural colleges on the use of explosives for blasting ditches. Our agricultural service men, several of whom are members of the American Society of Agricultural Engineers, will be pleased to cooperate with anyone interested in becoming more familiar with this subject.

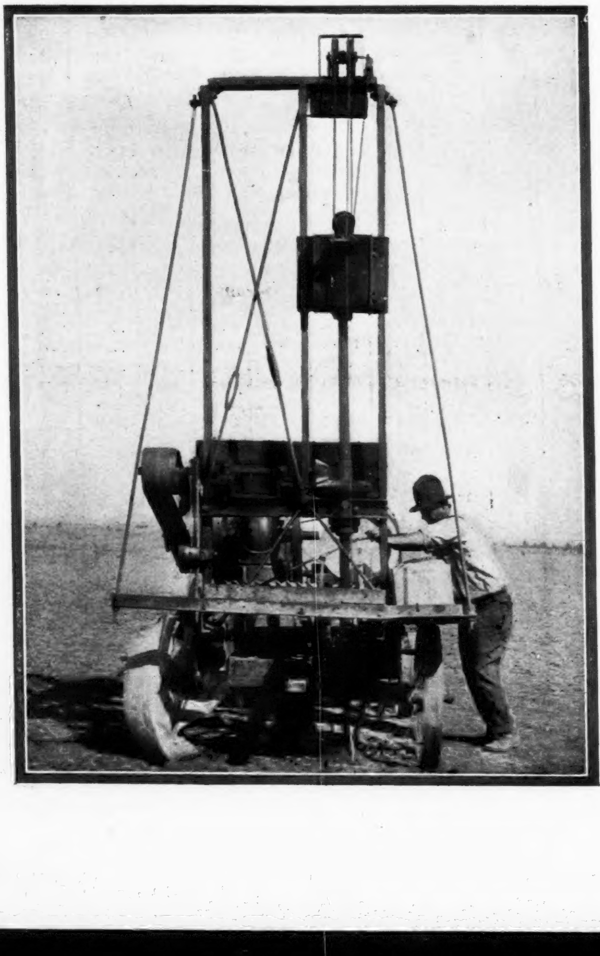
In many of the irrigated regions large areas of soil are underlaid with impervious hardpan strata. These are frequently caused by deposits of alkali salts left after the irrigation water has evaporated. Some of this hardpan has a consistency which approaches that of hardened cement.

In several of the famous fruit sections of California many carloads of dynamite are used annually in breaking up hardpan before orchards or vineyards are set out. Holes are bored or punched into it by hand or power machinery, and a pound or a small quantity of low-percentage dynamite (usually twenty per cent) is inserted. When the charge is detonated the hard strata is broken up sufficiently to allow the roots to penetrate and a better growth of the young tree or vine is insured.

Likewise orchard rejuvenation is carried on by blasting around the roots of matured trees to break up the hardpan formation which impedes their growth. While this use of dynamite may be of more interest to the horticulturist than to the engineer, the students in the majority of our agricultural colleges secure most of their information about explosives from the agricultural engineering department and, hence, the engineer should be fully familiar with the various purposes for which dynamite can be used on the farm.

Thus dynamite is playing an important role in improving irrigable land and will help render more fertile thousands of acres awaiting the magic which the drainage engineer performs in our arid regions with his canals and irrigation ditches.

In conclusion, the manufacturers of explosives desire to work as closely as possible with the agricultural engineer and the agricultural educational institutions in showing the farming public the proper use of explosives and in conducting experiments which will give us information that will make our products of the greatest service to mankind



Boring into hardpan preparatory to blasting it with dynamite, using hand augers and power-boring machine

Tile Drainage Investigations In North Carolina

By H. M. Lynde
Senior Drainage Engineer, Bureau of Public Roads, U. S. Department of Agriculture

For several years, in accordance with an agreement between the U. S. Department of Agriculture and the North Carolina Department of Agriculture, the federal department has maintained in North Carolina a drainage engineer who is assisted by an engineer provided by the state department for the purpose of promoting the practice of farm drainage in that state. The work is both research and extension and covers all phases of agricultural drainage. Underdrainage has not been practiced to a large extent in that and other sections of the South, and there is a great need and opportunity for experimental data on the subject, in anticipation of the time when tile drainage construction is bound to reach what may be termed the "popular stage" which now exists in the Middle West. It will probably be a long time before district land drainage by tile will be adopted, but many individual landowners are beginning to practice underdrainage.

It is the purpose of this paper to present in as concise a manner as possible, the methods used and results obtained in experiments conducted on two farms in northeastern North Carolina, for areas of 52, 23, 12, 10 and 7 acres respectively, thoroughly drained by parallel laterals. The records from which the data were compiled and studied were kept by paid and careful resident observers. Also they were continuous and cover considerable periods of time. On one farm the records cover a period of three years, the work being discontinued about a year ago. On the second farm records have been kept for twenty months and the work is still in progress. The drainage systems on both farms were designed and installed under our direction, and are situated on the comparatively level land of the Atlantic Coastal Plain. Other farms are being studied, but the work has not progressed far enough to present the data at this time.

The U. S. Weather Bureau reports summarize the climatic conditions of northeastern North Carolina as follows:

"The mean annual precipitation is about fifty-one inches, the largest monthly amounts occurring in August and the least in November. The season of heaviest precipitation is summer, with about 17 inches, while the least is autumn, with about 10.5 inches. The precipitation during winter averages 11.5 inches, and during spring it is about 12.75 inches. The snowfall is unimportant and the rivers very seldom freeze over. The average number of rainy days is about one hundred a year, the greatest number occurring in June, July and August, and the least in November.

The soils on the two farms are very different in character, but each farm is representative of a considerable area in the state. One farm represents conditions common to many of the second bottom lands along the rivers in the eastern part of the state. These soils are known as second terrace deposits, and are nonhomogeneous and extremely variable in texture and mottled beneath the surface. On the particular farm under investigation, in an area of 200 acres, twelve different soil types were identified, classified as loams, sandy loams, coarse sandy loams, fine sandy loams, clay loams, coarse loamy sands, coarse sands, and very coarse sands, of the four soil series known as Kalmia, Cahaba, Myatt, and Okenee. The surface color is generally gray to brownish, with subsoils of mottled gray, yellow, red, and brown sandy clays and clays. The textures vary in short distances, in

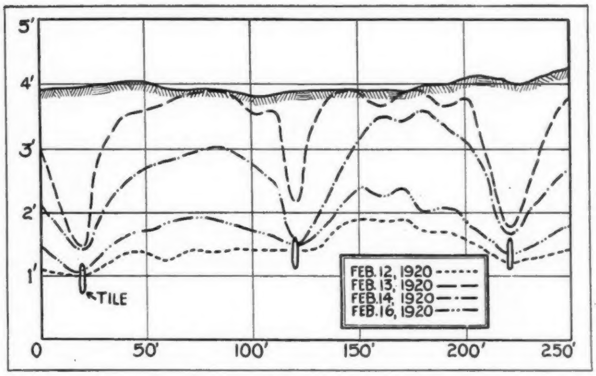


Fig. 1 Typical groundwater profiles across tile drains in non-homogeneous second bottom land

many instances only ten feet separate one kind of soil from another extremely different.

The drains are laid on a minimum grade of 0.2 per cent (2-3/8 inches fall to the hundred feet.) The average depth is 3 feet, with a spacing of 60 feet for laterals on one part of the tract, and 100 feet on another. The joints between tile are unprotected against the entrance of silt. Two systems, draining 52 and 23 acres, were studied on this farm.

The soil on the second farm is Norfolk fine sandy loam bordering on Portsmouth fine sandy loam, and consists of a gray fine sandy loam topsoil about 12 inches deep, underlaid by a yellow fine sandy clay. It is homogeneous in texture. The minimum grade of the drains is 0.2 per cent, but most of the grades exceed 0.3 per cent (3-5/8 inches fall to the hundred feet.) The average depth is 3 feet with a spacing of 100 feet. The tile were covered with a layer of pine straw before backfilling. Three systems, draining 12, 10 and 7 acres, respectively, were investigated on this farm.

The purpose of the experiments was to determine:

1. Amount of runoff from underdrained land.
2. Relation of runoff to rainfall
3. Action of tile drains in lowering the ground water level.

The runoff or discharge was measured by ninety-degree triangular weirs installed in weir boxes at the outlets to each drainage system. Continuous records of the heads on the weirs were obtained by automatic water register clocks, fitted with seven-day charts. On the two farms the five drainage units studied have separate outlets practically free at all times.

Daily rainfall records were obtained each morning for the preceding twenty-four hours by standard United States Weather Bureau rain gauges located near the centers of the tracts.

The ground-water level was determined by measuring the water level in observation wells installed at and between the tile in lines at right angles to the direction or flow in the drains. On the farm with a nonhomogeneous soil, two lines of wells were also installed parallel with the drains, the purpose of which will be brought out later. In all one hundred and fifty-two wells were installed on this farm, while the farm with a homogeneous soil had one hundred and ten wells. The wells were thirty feet apart where the lateral spacing was

Paper presented at the Southern Section meeting of the American Society of Agricultural Engineers at Lexington, Kentucky, February 14 to 16, 1921.

sixty feet, and twenty-five feet where the spacing was one hundred feet. In order to determine the shape of the profiles, some of the wells were spaced ten feet apart for short stretches. The distances from the top of the wells (the elevations of which had previously been determined) were measured each day for several days after a storm and two or three times a week during dry periods between storms.

Tables were prepared giving the discharges for different heads on the weirs reduced to inches in depth per twenty-four hours for each of the five drainage units. The discharges were obtained by scaling the heads on the weirs from the water register charts. The heads for each two-hour period (into which the chart was divided) were scaled and added together, and the sum divided by 12, thus giving the mean head for the day. From the tables just mentioned the discharge corresponding to this head was obtained. This discharge represented very closely the discharge for the day, except on days when the fluctuation in the head was large. On such days the discharge was obtained by adding together the discharges for each two-hour period. The discharges were computed for the 24-hour period, 8 A. M. to 8 A. M., in order to conform with the rainfall measurements.

The relation of the daily runoff to the daily rainfall were shown graphically on charts covering a period of one calendar year divided into months and days. The ground water profiles for several storm periods were plotted on profile paper. The object was to show the position of the ground water at its highest and lowest positions and as many intermediate ones as could be shown distinctly.

Some interesting results were obtained. The experiments are still in progress on one of the farms, but enough data have been compiled and studied to show the trend of the results.

Since the effect of the tile drains in lowering the ground-water level after storms is really the determining factor in the success of any underdrainage system, this phase of the experimental work will be discussed first, followed by a discussion of the rainfall and runoff.

During the three years that the experiments on the non-homogeneous second bottom land soils were being conducted, there were eleven storm periods which justified study, four in 1917, three in 1918, and four in 1919. The noticeable feature of the water profiles in these soils is their marked irregularity due to the variableness of the soil. Attention is called to Fig. 1, which is a short section typical of the profiles at right angles to the lines of tile. At first glance it does not seem to indicate much of value, except that the water table rises and falls under the influence of the rainfall. The curves certainly do not resemble the generally accepted shape for curves of this kind.

Fig. 2 represents a short section typical of the ground water profiles parallel with the drains. In a soil of uniform texture it is to be expected that these profiles would be straight lines. As is apparent, however, Fig. 2 does not differ materially in appearance from Fig. 1. The irregularity of the profiles and the similarity of Figs. 1 and 2 indicate that the soil texture varies considerably in short stretches, and that ground water profiles in soils of this character are unreliable for determining the average level of the ground water, or the correct depth and spacing for laterals.

Some parts of the tract are drained well, others apparently are not, because the water-yielding capacity of the soil is deficient. To me these profiles indicate that the texture of the soil is the controlling factor in the efficiency of any underdrainage system.

On the second farm, with homogeneous Norfolk and Portsmouth fine sandy loams, the data have been compiled and studied for a period covering only one year, although the experiments have been in progress twenty months to date. During the first year ending June 30, 1920, the ground-water profiles were plotted for seven storm periods. Fig. 3 represents a short section typical of profiles in these soils which

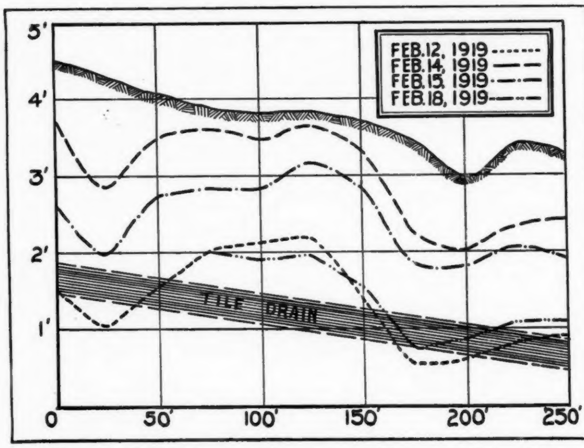


Fig. 2. Typical groundwater profiles parallel with tile drains, non-homogenous second bottom land

are open and of uniform texture. A study of all the profiles plotted indicates that within twenty-four hours after the soil is saturated to the surface between drains, the water will have fallen from 6 to 12 inches and that it takes from 4 to 5 days for the water table to sink level with the drains. It is thus seen that the crops have a chance to recuperate from the effects of one storm before another occurs. The soil is sufficiently open so that the degree of drainage desired can be regulated by the spacing and depth of the laterals, as indicated by the V-shaped space directly over the drains. The water table has seldom risen more than a foot directly over the tile. Although it has reached the surface midway between drains in several instances, it has receded quickly from this position.

A study of the average of all the highest ground-water levels obtained to date indicates that no water appeared on the surface for a distance of about 20 feet on each side of the drains. This would seem to indicate that if the drains had been spaced 40 to 50 feet apart at a depth of 3 feet, water would seldom rise to the surface between drains. On the other hand, if the drains were placed 5 feet deep and 100 feet apart, water would likewise seldom reach the surface, assuming of course that the soil texture remains the same. Reasoning along the same line, it seems probable that if the drains were spaced 125 feet at a depth of 3½ feet or 135 feet at a depth of 4 feet, drainage equal to that of the present arrangement could be obtained.

During the three years the experiments were conducted on the first farm, 1917 through 1919, the daily rainfall was 1 inch or over on 35 days, 2 inches or over on 5 days, 3 inches or over on one day, and 4 inches or over on one day. The maximum daily rainfall recorded was 4.5 inches.

On the second farm, for the approximately one year that the data have been compiled, the daily rainfall was 1 inch or over on 18 days, 2 inches or over on 5 days and almost 3 inches on one day. The summer of 1919 was exceptionally wet.

The topography of both farms is comparatively flat and the tile systems are not called upon to take care of any outside water. There probably is very little surface runoff so that practically all the rainfall passes off through the underdrainage systems. There are some breaks in the runoff records due to the fact that the automatic water register clocks occasionally got out of order, but it is believed that little data of value were lost from this cause.

Taking the drainage unit on the farm with nonhomogeneous soils which recorded the largest discharges, an analysis for the three years shows that the daily runoff was ¼ inch in depth or more on 12 days, ⅜ inch or more on 4 days, and ½ inch or more on 2 days. It is thus seen that the daily runoff

exceeded ¼ inch on an average of only 4 days in a year. Allowing for breaks in the records, it is believed that it is safe to say the daily runoff never exceeded ¼ inch on an average of more than 6 days a year.

There were some peaks or flood runoffs at greater rates than the daily runoffs, but these lasted for only an hour or two, when there would be a sudden drop. In three instances these peak rates exceeded ¾ inch. The increase and decrease in the runoff was very rapid during and after a heavy storm. The flow often rose from a minimum to a maximum in a period of two hours' time or less, but fell somewhat slower, although usually within 24 hours after reaching the maximum. The maximum was reached some hours after the rain began. Large runoffs occurred at all seasons of the year and for rains of all intensities. The tile systems never ran dry, due undoubtedly to seepage water in the soil from adjoining high land.

On the second farm, the records for the first year indicate, for the drainage unit giving the largest discharges, a daily runoff of ¼ inch or over on 23 days, ⅜ inch or over on 12 days, and ½ inch or over on 8 days. The drainage systems on this farm are dry for long periods at a time, and sometimes rains as heavy as one inch caused no flow. The summer of 1919, as previously mentioned, was extremely wet and during one protracted storm period, when during eight days 9.74 inches of rain fell, the runoff exceeded ¼ inch on 8 days in succession, ⅜ inch on 3 days and ½ inch on 2 days. About every three or four years, eastern North Carolina experiences a wet summer and 1919 was one of these years.

Studying the discharge records of both farms in conjunction with the ground water profiles, it appears that the rate of runoff is but a measure of the rate at which the water moves through the soil to the drain. An interesting study would have been to compare the number of days on which a runoff rate of ¼ inch was exceeded on the two kinds of soils, for the same period of time, when all conditions were nearly similar except the soil. By this means the efficiencies of the drainage systems on both farms might be compared. If, for instance, the runoff exceeded ¼ inch on a certain number of days on the open textured soils, and a certain number of days (probably less) on the stiffer soils, and the drainage of the open soils be assumed as 100 per cent efficient, then the per cent of efficiency of the other soils might have been approximately determined. Such a comparison was impossible, however, for the only time such a comparison could have been made was during the wet summer of 1919, and the weirs on one of the farms were submerged part of the time.

As distinguished from the farm with a nonhomogeneous soil, there were no extreme fluctuations in the discharges on the farm with an open homogeneous soil, and there were no peaks. Although the discharge increases very rapidly after a heavy rain to a maximum, it usually falls rather gradually at the end of the storm.

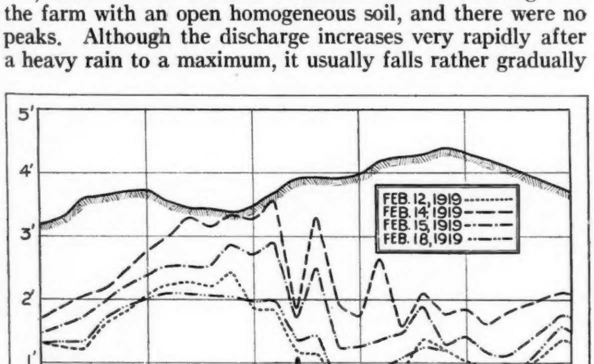


Fig. 3. Typical groundwater profiles across tile drains, Norfolk and Portsmouth fine sandy loam

On both farms the discharges for a few hours at a time were apparently larger than the calculated capacities of the tile mains (which were designed for a ¼ inch runoff using the Chezy-Kutter formula with $n = 0.015$.

There seems to be no relation between the character of the storm and the runoff. The amount of rainfall rather than its intensity seems to be the determining factor in the amount of runoff. A thunderstorm will show an increase in discharge just as much as a rain covering a period of several hours, as nearly as could be determined. Many of the summer rains in North Carolina are thunderstorms and some of the largest runoffs were due to them.

Just how may the results be interpreted? Can any clean-cut or definite conclusions be drawn from them, or is there danger in attempting to do so? In any set of data such as have been presented, certain relationships are bound to be obscured, and the conclusions arrived at can only be very general in character. In order to apply the results, it must first be decided in the experimenter's mind whether the drainage systems are performing their functions well. I believe they are so far as the engineering features are concerned, but no drainage system can carry off the water faster than the soil will deliver it to the drains. On both farms the drains appear to be able to handle the water as fast as it is received. There is some question in my mind whether the nonhomogeneous soils are of a sufficient water-yielding capacity to obtain the best results from underdrainage, although there is no doubt but that conditions have been greatly improved by its installation.

The results, as I see them, may be briefly summarized as follows, bearing in mind that they can only safely be applied to areas where soil conditions, topography, rainfall and climate are similar:

1. The texture of the soil is the controlling factor in the efficiency of underdrainage.

2. In nonhomogeneous soils the spacing and depth of drains should be such as to suit average soil conditions as nearly as they can be ascertained, consistent with economy.

3. In general, in nonhomogeneous soils, laterals should be arranged in parallel straight lines at equal distances apart and at the same average depth. For North Carolina second bottom lands of this character a minimum spacing of 60 feet and maximum depth of 3 feet are recommended. It is not believed that the additional benefits to be derived from spacing them closer or deeper than those figures will justify the cost.

4. For Norfolk and Portsmouth fine sandy loam soils, with a surface slope exceeding 3 inches to the hundred, a spacing of 125 feet and an average depth of 3½ feet are recommended for laterals. On slopes flatter than this a spacing of 100 feet and a depth of 2 feet are recommended on account of the possible existence of basins and no surface runoff.

5. The economic rate of runoff to be adopted in the design of underdrainage systems on areas similar to those investigated, appears to be ¼ inch per 24 hours if the Chezy-Kutter formula with $n = 0.015$ is used. This was the factor used in the design, and there seems no reason for increasing it, since the crops on the open-textured soil did not suffer injury and the surface water was removed quite quickly. Possibly for Norfolk and Portsmouth fine sandy loams with extremely flat topography, it may be advisable to provide for a ⅜ inch runoff, if the laterals are spaced closer than 100 feet.

6. The grades of the drains on the two experimental tracts are 0.2 per cent or greater and are self-cleaning. Observations on tracts with similar soils where the grades are less than 0.2 per cent appear to indicate that there is danger of silting in the smaller tile, unless the joints are protected, which may be done by wrapping with strips of building paper and covering with pine straw.

Agricultural Engineering Development

A Review of the Activities and Recent Progress in the Field of Agricultural Engineering Investigation, Experimentation and Research

Edited by **R. W. Trullinger**

Mem. A.S.A.E. Specialist in Rural Engineering, Office of Experiment Stations, U. S. Department of Agriculture

COMPARATIVE EXPERIMENTAL STUDIES ON HAY AND SILAGE CUTTERS, M. Conti (Revista de la Facultad de Agronomia y Veterinaria (Buenos Aires), 3(1920). No. 2, pp. 138-148, figs. 5) Studies made in connection with work in progress at the National University of Buenos Aires on the development of the most rational type of knife for hay and silage cutting are reported.

Two general types of cutter are distinguished: (1) Those with the knife mounted on a circular revolving frame at right angles to the axle of rotation, and (2) those with the knife mounted on a revolving cylinder parallel to the axis of rotation.

Tests of four cutters, two of the first type and two of the second type, are described. The two right-angle cutters and one of the cylinder cutters were of the hand-operated type, and the fourth cutter was a large engine or motor-operated type. One of the right-angle cutters had two straight blades and the other two curved blades of so-called logarithmic spiral shape. The hand-operated cylindrical cutter had one helicoidal shaped blade and the motor-operated cutter two helicoidal shaped blades. The respective operating speeds were 50 to 60, 50 to 60, 100, and 600 revolutions per minute, and the respective maximum diameters of revolutions were 27, 42, 7.3 and 10 inches. The knife lengths of the cylinder cutters were 11 and 10.6 inches respectively.

The tests were conducted with dry corn. The quantity of cut stalks from the first three cutters varied with the speeds from 295 to 550 pounds per hour. Ten stalks were fed at a time to these cutters and fifteen stalks to the motor-operated cutter. The amount of mechanical energy utilized by each cutter is shown in the following table:

ENERGY ABSORBED BY SILAGE CUTTERS

Cutter	R.P.M.	Length of Cut	Energy Absorbed in Cutting	Energy Absorbed at Each Cut	Energy Absorbed Running Empty	Cuts Per Second
No. 1	64	1.6	171.0	77.3	48.8	2.20
No. 1	100	1.6	94.6	28.4	......	3.30
No. 1	100	0.8	97.3	29.6	......	3.30
No. 2	64	0.8	123.0	55.4	64.9	2.20
No. 2	100	0.8	73.0	22.2	......	2.20
No. 3	100	1.6	77.0	45.6	73.0	1.66
No. 3	240	1.6	61.0	15.2	......	4.00
No. 4	600	1.2	723.0	36.2	97.5	20.00

The mechanical energy absorbed by the three hand-operated cutters was inversely proportional to the speed. About twice as much energy was required by the hand-cylinder cutter per cut as was required by the two other hand machines when operating at the same speed. The spiral-shaped knife cutter was superior to the straight knife cutter. The length of cut apparently did not influence the energy requirements.

An analysis of the force in pounds exerted at the knife edge at each cut showed that cutter No. 1 exerting cutting forces of 44 and 14.5 pounds and cutter No. 2 exerted cutting forces of 29 and 10.5 pounds when operating at respective speeds of 64 and 100 revolutions per minute. Cutter No. 3 exerted cutting forces of 24 and 8 pounds when operating at respective speeds of 100 and 240 revolutions per minute. Cutter No. 4 exerted a cutting force of 30 pounds when operating at a speed of 600 revolutions per minute.

These results are taken to indicate the advantage of cutters Nos. 2 and 3, and also the necessity of establishing a definite relation between the geometric form of the knife, a convenient peripheral speed, and the weight of the frame.

PALM OIL MOTORS, R. Mayne, (Annales de Gembloux, 26 (1920) No. 11 pp. 509-515, M. Weissenbruch, Brussels, Belgium.) Analyses of samples of palm oil for use in internal-combustion engines are given and discussed.

This oil is extracted from the pulp of palms and palm fruit, and consists of a mixture of palmitate and oleate of glycerine with acid in variable proportions. It is yellow or red in color and of a buttery consistency at ordinary temperatures. The analyses show that the melting point of palm oil is from 37 to 48 degrees, Centigrade, so that its practical use as a fuel is apparently limited to torrid climates unless artificial means of preheating are provided. A calorific value of 9,228 calories is given. Data are given showing that the production of palm oil in different parts of West Africa is quite extensive.

Preliminary tests of this fuel, especially in semi-Diesel engines, have shown that complete combustion is assured by vaporization of the fuel and injection in quantity strictly proportional to the load. The composition of the gaseous mixture should be constant, which condition is obtained by the injection of an amount of water proportional to the load and to the amount of fuel injected. The scavenging of burned gases should be very effective.

Palm oil is shown to have a flash point of about 187 degrees and a burning point of about 210 degrees, Centigrade.

BACTERIOLOGICAL STUDIES OF BIOLOGICAL PURIFICATION, J. Groenewege (Mededeelingen uit het Geneeskundig Laboratorium te Weltevreden (Dutch East Indies) 3. Ser. A. No. 4(1920), pp. 66-125, pl. 1; also in Bulletin du Jardin Botanique, Buitenzorg, Java. 3, ser., 2(1920), No. 2, pp. 203-236, figs. 6). Attention is drawn to the present lack of knowledge of the purification processes in septic tanks, and the results of studies of the gases formed in septic tanks under certain conditions are reported. These gases were found generally to include methane, carbon dioxide, hydrogen, and nitrogen. Methane apparently is formed in large quantities.

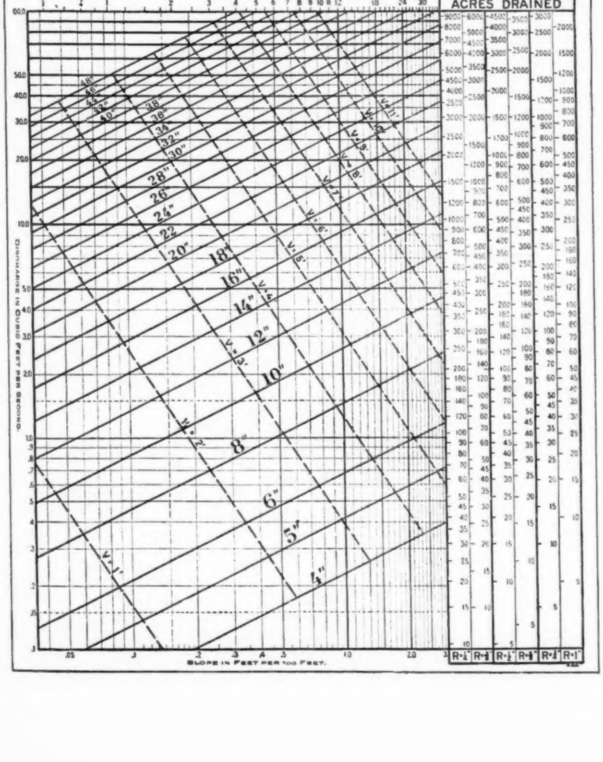
The breaking down of the carbohydrates and albuminous matter in sewage, and the formation of hydrogen, carbon dioxide, and hydrogen sulphide are considered to make up the first phase of the purification process. The second phase is considered to be the formation of methane, since the end products of the first phase were found to be excellent nutri-

tive media for the methane forming organisms. Methane formation was found to proceed slowly at first but, aided by the proper flow of sewage through the tank, reached a point of high activity after two or three months. The constant addition of new matter in the sewage, such as sources of hydrogen, sulphur, and carbon dioxide, was found to hinder methane formation. Biological evidence of methane formation was always found in the sludge of properly operating septic tanks, although the active flora of such sludge was usually quite sparce. It was found that a condition of equilibrium of methane formation is maintained in a properly operating septic tank through the addition of new sewage and the proper draining off of the effluent. Methane formation is, therefore, considered to be an important factor in the design and operation of a septic tank.

Hydrogen formation was found to result almost exclusively from anaerobic processes, including the fermentation of carbohydrates, albuminous matter, and formic acid salts. Part of the hydrogen formed was found to combine with carbon dioxide, forming methane, this taking place in both the liquid and sludge. Carbon dioxide formation resulted from the methane and all of the hydrogen-forming processes. Large quantities of carbon dioxide escaped in the effluent so that the carbon dioxide content of the escaping gases from a septic tank cannot be taken as a measure of the carbon dioxide formation in the tank.

Nitrifying bacteria were found to be quite active in septic tanks. Their action was hindered by cutting off ventilation and by the entrance of a too high concentration of organic matter. Nitrogen in the escaping gas was found to result from the nitrification of absorbed ammonia to nitrites which, when in solution, were attacked by denitrifying bacteria and reduced to gaseous nitrogen. Thus it was found that nitrogen escapes in the gases from open ventilated tanks but not from closed unventilated tanks. The presence of easily assimilable organic matter was found to retard nitrification most strongly.

Analysis of gases escaping from septic tanks showed that there is more carbon dioxide and methane formed in closed than in open tanks, and that the methane content of the sewage at the entrance of a tank is usually greater than at the outlet. Thus nitrites are formed under conditions which hinder methane formation.



Studies on the influence of velocity of flow in a septic tank on the escaping gases showed that with the same velocity the open tank produced more nitrogen and less methane than the closed tank. Decreasing the velocity of flow decreased the carbon dioxide production and increased denitrification, but owing to the increase in organic matter decreased nitrification.

Studies of the distribution of nitrites and methane showed that nitrification and denitrification processes were taking place at the surface and gradually decreased to a certain depth where they suddenly ceased entirely. At this point methane formation begins. It is thus concluded that methane formation is regulated entirely by the nitrites present and not by the addition of compounds which are easily fermented to methane and carbon dioxide. It was also found that hydrogen sulphide usually exists in the deeper layers of sewage in properly operating tanks owing to a proper regulation of nitrification.

THE FLOW OF WATER IN DRAIN TILE, D. L. Yarnell and S. M. Woodward, (United States Department of Agriculture, Washington, D. C. Bulletin No. 854 (1920). pp. 50, pls. 13, figs. 5.) This is a progress report of an investigation being conducted on the carrying capacity of tile drains as conduits. The results of 824 separate tests are reported on commercial sizes of clay and concrete tile varying from four to twelve inches in inside diameter. The capacity of different depths of flow was also determined. For comparison, 69 tests were made on ten and twelve-inch tile so laid as to approximate closely poorly laid drains found in the field.

It was found that the value of the coefficient of roughness n in the Kutter formula, as obtained by experiments in a drain or pipe at any depth of flow less than full, does not necessarily apply to that drain of pipe when flowing full. It was also found that the Chezy formula gives the same velocity of flow in a pipe flowing one-half full as in one flowing full with the grade constant. The experimental data obtained seemed to disprove this theory and showed that the exponent of the slope s is practically 0.5, and that the exponent of the mean hydraulic radius R is two-thirds. From these data a new formula is tentatively presented for computing the flow in drain tile flowing full, as follows: $V = 138\ R^{2\text{-}3}\ s^{1\text{-}2}$ in which V is the velocity, R is the mean hydraulic radius, and s is the slope.

The accompanying diagram shows discharge capacities for various rates of run-off based upon this formula covering tile sizes from four to forty-eight inches and grades from 0.04 to 3 per cent. A detailed description of the equipment and methods used is given, together with tabulated data from the experimental work. The data are also graphically reported and the method of developing curves is explained.

Experiments on the loss of head in catch basins are also reported indicating that the use of reducers with the tile flowing approximately full reduces the loss of head to practically nothing, while with tile flowing half full some loss of head occurs. Without reducers the loss of head decreases with the decrease in slope. The variation in drop in the catch basin did not materially affect the loss of head.

SEPTIC TANKS FOR RURAL HOMES, H. B. Roe (University of Minnesota College of Agriculture Extension Division Special Bulletin published at University Farm, St. Paul, 50 (1920) pp. 20, figs. 14.) The author summarizes his own experience and that of others on the design and construction of sewage-disposal systems for rural homes, and presents working drawings and bills of material and labor for the construction of standard systems.

It is concluded that the best and simplest sewage-disposal plant for the individual rural home at present is a two-chamber septic tank connected to a tile drain having a good outlet or leading to an absorption bed. The general shape of the septic tank should be rectangular, the sludge chamber being about twice as long as it is wide and not more than four feet wide, with a fluid depth of about thirty inches and an air space above the scum of approximately one foot. Light, acids, and greases should be excluded from the tank, and the entrance and discharge of matter should be so controlled as to prevent disturbance of the scum. The sludge chamber should be of a size to accommodate house discharge up to thirty gallons per capita per twenty-four hours.

THE FLOW OF WATER IN DREDGED DRAINAGE CHANNELS, C. E. Ranser, (United States Department of Agriculture, Washington, D. C. Bulletin 832 (1920), pp. 60, pls. 20, figs. 13). This bulletin reports and summarizes a series of experiments to determine the values of the roughness coefficient *n* in Kutter's formula which will properly apply to the various conditions of dredged drainage channels. The experiments were conducted in Lee and Bolivar Counties, Mississippi, western Tennessee, western Iowa, southern North Carolina, and eastern Florida.

It was found that a deposit of slick, slimy silt on the sides and bottom of a channel and the clearing out of perennial growth reduce frictional resistance to flow and increase the capacity. The growth of grass and weeds and the accumulation of drift trees, logs, and other obstructions in the channel greatly decrease the capacity. After a certain amount of erosion has taken place in a channel further erosion does not necessarily increase the roughness of the perimeter.

The roughness coefficient *n* was found to be appreciably higher for a roughly dredged channel than for a smoothly dredged one, and abrupt variations in cross sections are active in reducing the hydraulic efficiency of a channel. Ordinarily a dredged channel quickly deteriorates in hydraulic efficiency unless systematically maintained.

The conclusion is drawn that generally in designing a proposed dredged channel, a value of *n* of 0.03 should be used if the channel is to be smoothly dredged, and of 0.035 if roughly dredged. If these values are used the channels should be carefully maintained, and if not so maintained a value of *n* should be selected in accordance with the worst anticipated conditions for the channel. In computing the capacity of an existing channel, the value of *n* chosen should be based upon a comparison of the conditions in the existing channel with the conditions of channels for which values of *n* have been determined.

INVESTIGATIONS ON FUNDAMENTAL PRINCIPLES IN WOOD CONSERVATION, F. Moll, (Untersuchungen uber Gesetzmassigkeiten in der Holzkonservierung, Jena, Germany; Gustav Fischer, 1920, pp. (3)—23). Studies on the action of inorganic compounds on the fungi which cause decay in wood are reported, the purpose being to establish the fundamental principles of such action as related to the treatment of wood for preservation.

It was found that the poisonous action of salts against wood-destroying fungi is an additive action of the ions. The poisonous ions tested were found to be in the order of their effectiveness, mercury, silver, cadmium, cyanide, copper, zinc, iron, cobalt, chromium, and fluorin. Magnesium and aluminum ions, considered to be the most alkaline and acid ions, respectively, were practically ineffective. The poisonous action was found to depend on the solubility in water of the salt and its ability to disassociate in ions in solution. Each ion possessed a specific poisonous action as well as ability to enter into a specific chemical reaction. The effectiveness of compound ions was found to depend upon the individual action of each of their constituents.

Mixing of other salts with active compounds retarded disinfection or hastened it, but did not influence the final results. The effectiveness of a given quantity of a soluble salt or salt mixture was found to depend solely upon the quantity of active constituents in the solution or mixture and on their specific effectiveness.

It is concluded that these experiments place the use of salt mixtures for the impregnation of wood as a protection against decay and fire on a new scientific basis. As long as the mixed salts do not form insoluble precipitates or complex compounds, each individual ion is concluded to retain its specific effectiveness unchanged and the effectiveness of the mixture as a whole can be considered as the sum total of the effectiveness of the individual ions or molecules.

HEAT TRANSFER IN BUILDING MATERIALS, L. M. Arkley (University of Toronto, Engineering Research School Toronto, Canada, Bulletin No. 1, pp. 115-129). The results of tests in progress since 1912 to assist in the selection of building materials are reported. The object of the tests was to compare the insulating values of walls of approximately equal thickness, namely, 8-inch hollow concrete block, 9-inch brick, and 7¾-inch hollow tile walls; also to determine the effect of plastering the walls and of stopping air circulation in hollow walls by filling the spaces with cheap materials, or by using paper on the inside of the walls. The material to be tested was built as a wall of about 20 square foot surface dividing a test chamber into two compartments. One compartment communicated directly with a refrigerating plant and was thus maintained at 20 degrees Fahrenheit or lower. On the opposite side of the wall heat was supplied by an electric heater. Readings were taken when steady temperature was attained in the two compartments. The following table gives typical values for the heat transmission coefficient determined for the various walls under the conditions specified:

Tests 1, 9, and 11 show that a hollow block wall is not more efficient as regards heat insulation than a solid brick wall of approximately equal commercial standard thickness. Tests 2, 3, 5, and 12 show, however, that the heat transfer is reduced considerably if the spaces in the hollow block wall be filled with some material which separates the air into small pockets and prevents circulation. Tests 4 and 7 show that one layer of tarred building paper on the high temperature side of the wall reduces the heat transfer by nearly fifty per cent. Test 9 serves as a check on the work, as many other tests on 9-inch brick walls have given an average value of 0.4 B. t. u. for the heat transmission coefficient. The brick wall used in these tests was built no better than the ordinary bricklayer's practice; the hollow-tile was, however, built much better than would be done in ordinary contract work and the test results obtained are, therefore, more favorable to the hollow-tile wall than could be realized in ordinary construction.

The principal results regarding miscellaneous materials showed (1) the marked effect of a layer of paper in reducing heat transfer; (2) that one coat of "dehydratine" gives practically the same result as a layer of paper; (3) the hollow-tile wall is a better heat insulator when the hollow spaces run horizontally than when they are vertical, and (4) plaster is a poor heat insulator.

Various special constructions tested are illustrated and full test data are given.

Rice Irrigation Measurements and Experiments in Sacramento Valley, 1914-1919, F. Adams, (California, Berkeley, Station Bulletin 325 (1920), pp. 69, figs. 4). This bulletin supplements a previous bulletin by Robertson and summarizes and discusses the results previously reported, together with the results of later water measurements and rice irrigation experiments. The work was done under a cooperative agreement between the United States Department of Agriculture, the California state department of engineering, and the state water commission.

A total of forty-three full-season field observations on the use of water on rice were completed during the year 1916, 1917, and 1918. The average net depth of water applied to 22,404 acres during these observations was 4.89 feet. Of this area 21,419 acres were clay or clay adobe. A four-year record of use of water on 39.5 acres of Stockton clay adobe, well prepared and irrigated, showed a range in depth of water applied of from 4.27 to 4.87 feet, with an average of 4.53 feet. An annual depth of 5 feet of irrigation water for rice was found to be sufficient for the principal rice soils of the Sacramento Valley, including the clays and clay adobes of the Willows, Stockton, Sacramento, Capay, and Yolo series. Pervious loam soils were found to require an excessive amount of water, and for this reason are considered to be unsuitable for rice growing.

The use on individual fields of one cubic foot per second of irrigation water to from thirty to forty acres during the first flooding after seeding is not considered excessive. The seasonal use on this basis averages about one cubic foot per second for each sixty-five acres. About one-third of the water applied to rice fields was lost by evaporation from the surface of the standing water during submergence. As in the previous experiments, it was found that maximum rice yields were obtained from submerging the fields six inches deep, beginning thirty days after emergence of the plants above ground, except on alkali soils where the submergence was best begun fifteen days after emergence.

Constant movement of the irrigation water through the rice checks during the period of submergence was necessary only where the soil contained alkali in sufficient quantities to affect the plants. Keeping the rice field only moist or muddy throughout the growing season gave reduced yields of poor quality. The experiments so far have not fully demonstrated that fluctuating the depth of submergence is beneficial.

"It is imperative that ground water and rise of alkali be controlled in California rice fields, both by confining rice growing to the heavier, impervious clays and clay adobes and by thorough and adequate drainage facilities embracing the entire areas affected or likely to be affected. A prime factor in control of water grass in rice fields is the keeping of banks of canals and ditches, principally lateral and field ditches, entirely free of this pest."

TABLE OF HEAT TRANSMISSION COEFFICIENTS

No. of Test	Walls and Conditions	B. t. u. transferred per one degree difference of temperature per hour per square foot.
1	Hollow concrete block wall. Not plastered. Air spaces empty	0.630
2	Hollow concrete block wall. Not plastered. Air space filled with sawdust	0.438
3	Hollow concrete block wall. Plastered both sides. Air space filled with sawdust	0.342
4	Hollow concrete block wall. Plastered both sides. Air spaces empty	0.506
5	Hollow concrete block wall. Plastered both sides. Air spaces filled with gravel	0.385
7	Hollow concrete block wall. Plastered both sides. Air spaces empty. One layer of tarred building paper on high temperature side of wall	0.258
9	Brick wall without plaster, 9 inches	0.392
11	Hollow tile without plaster. Air spaces empty	0.416
12	Hollow tile without plaster. Air spaces filled with gravel	0.355
13	1-ply oiled paper	1.38
14	Wall of wood shavings 5 inches thick	0.276
15	Corrugated galvanized iron wall supported on 2-by-4-inch frame	1.2
16	Beaver board $\frac{3}{16}$ inch thick	0.83
17	Asbestos corrugated sheathing $\frac{1}{8}$ inch thick	1.13

What it Costs to Haul Grain by Truck, J. C. Thorpe (*POWER FARMING*, St. Joseph, Michigan, 30 (1921), No. 1 pp. 12, 13, 20, figs. 2). A report is given of the summarized operating data on about three hundred farms in hauling small grain from threshing machines to grain stations by truck and team.

Two trucks were used of one ton and two tons rated capacity of the following general specifications:

Specifications		One ton	Two ton
Motor, (4 cylinder)		$3\frac{3}{4}$ x $5\frac{1}{4}$	$3\frac{3}{4}$ x $5\frac{1}{4}$
Transmission		3 speeds forward	4 speeds forward
Wheel Base		130 inches	144 inches
Gear ratios,	1st	21.76 to 1	45 to 1
	2nd	12.71 to 1	31.4 to 1
	3rd	6.80 to 1	18.0 to 1
	4th		10.2 to 1
	Rev.	26.38 to 1	53.7 to 1
Tires		Pneumatic	Pneumatic
Front		35x5	36x6
Rear		36x6	40x8
Normal Carrying Capacity		100 bushels of oats	150 bushels of oats

The cost of hauling by truck was determined on the basis of fixed charges per day for interest, insurance, taxes, depreciation, annual overhaul, and driver of $7.72 for the one-ton truck and $9.05 for the two-ton truck and for operating costs per mile of $0.091 and $0.120. The cost per hour for team work was estimated at 36.7 cents exclusive of the driver's time.

It was found that it cost the least per bushel for hauling by the one-ton truck overloaded from twenty-five to seventy-five per cent. Under normal load and operating conditions the data indicate, however, that for hauls up to about four and one-quarter miles team hauling is cheaper than the use of the one-ton truck. When the haul exceeded one mile the advantage was found to be decidedly in favor of the two-ton truck. It is concluded that the one-ton truck operated at its normal capacity has no advantage over teams for this kind of work except for long hauls.

Inclined Bearing Tests on Douglas Fir and White Pine, T. R. Simpson, (*Engineering News-Record*, New York, 85(1920) No. 14, pp. 654, 655, figs. 4). A series of tests, conducted at the University of California, on the bearing strength of Douglas fir and California white pine, when the bearing surface was inclined to the grain, is reported.

It was found that there was a close check with the Jacoby formula when the elastic-limit load was taken as the criterion of permissible value, and an approximate agreement with the Howe formula when a fixed depth of indentation was taken as the criterion. It is concluded that the Jacoby formula appears to express the proper relation between load and angle of grain and should be used. It is as follows:

$$n = p \sin^2\Theta + q \cos^2\Theta$$

in which p = allowable intensity of stress in end bearing, q = allowable intensity of stress in cross bearing, and n = allowable intensity of stress on a surface inclined at an angle with the grain.

A. S. A. E. and Related Activities

College Section Executive Committee Meets in Washington

AT THE call of the chairman and through the courtesy of the Division of Agricultural Engineering, Bureau of Public Roads, U. S. Department of Agriculture, a meeting of the executive committee of the College Section of the American Society of Agricultural Engineers met in Washington, D. C., May 9 and 10, 1921. Members present were William Aitkenhead, R. U. Blasingame, J. B. Davidson, F. W. Ives, S. H. McCrory, E. R. Raney, and O. W. Sjogren. Other members of the Society present were M. C. Betts, R. W. Trullinger, and E. R. Barrows.

The purpose of calling the meeting of the committee was to effect a permanent organization and to bring about a closer cooperation between agricultural engineering agencies in the U. S. Department of Agriculture and state colleges of agriculture and experiment stations.

The chairman, F. W. Ives, was elected secretary of the Section.

The following major heads were recognized as the work of the College Section:

1. Permanent organization
2. Cooperation with U. S. Division of Agricultural Engineering
3. Research
4. Cooperation with manufacturers and other outside interests
5. Standardization (Standard practice as applied to education)
6. Methods of instruction
7. Extension instruction

Permanent organization having been effected, the main topic of discussion was cooperation.

It was agreed that local problems coming to U. S. Division of Agricultural Engineering be referred to state agencies so far as expedient for the following reasons:

1. Regional problems best solved by those closely in touch with them
2. Better feeling between colleges and U. S. Department of Agriculture
3. Let people know they have a college and experiment station

In the furtherance of cooperation, Mr. Trullinger announced that he was preparing extracts of pertinent matter for AGRICULTURAL ENGINEERING. It was also stated that funds of agricultural experiment stations would be distributed so that agricultural engineering would be included so far as practical.

The following colleges are without departments of agricultural engineering on farm mechanics: Maine, New Hampshire, Vermont, Rhode Island, Delaware, South Carolina, Arkansas, Wyoming, Nevada, New Mexico, and Arizona. Action was taken to have the Secretary send all deans and directors of agricultural colleges and experiment stations in these states copies of the section of the new Constitution of the Society relating to the College Section, and notifying them of their entitlement to representation at the annual meeting of the American Society of Agricultural Engineers.

Thirty-five problems for research were outlined. The chairman of the Section was instructed to write up these projects fully and to cooperate with the Secretary of the Society in publishing these projects, and to get them into the hands of all deans, directors, and heads of departments of agricultural engineering or farm mechanics that early action might be had in securing cooperation and avoiding duplication.

The letter accompanying this outline of projects is to ask for the following information:

1. Work in progress
2. Suggestions as to part they can take up in carrying out the program
3. Expression of their willingness to assist in the conduct of outlined projects
4. Suggestions for new projects
5. Reasons for each item in prescribing project topics
6. Work considered completed

This information is to be collected by the Secretary of the Society and with the chairman suggestions as to future action are to be made to men working in agricultural engineering and information furnished to directors.

The committee, after deliberation, wrote to Secretary of Agriculture, Henry C. Wallace, as follows:

"In the reorganization of the departments of the national government it is proposed that all engineering work be placed under one head. As the Executive Committee of the College Section of the American Society of Agricultural Engineers we take the liberty to suggest that the Division of Agricultural Engineering of the Bureau of Public Roads, if not the entire bureau, be retained in the Department of Agriculture for the following reasons:

1. The problems of the agricultural engineer necessitate practical and intimate knowledge of farming processes and conditions
2. The problems of the agricultural engineer are peculiar in that they demand the active and very close cooperation of agencies such as soils, crops, dairy, and animal husbandry divisions
3. The growth and development of agricultural engineering has been fostered by the agricultural rather than the engineering colleges
4. The technical engineering agencies would not have the sympathy for this newer development in engineering, and if included in the combination of engineering agencies would lose the prestige it has gained among colleges and experiment stations on sheer ability to apply engineering to farm problems
5. The problems of greater farm production per man unit can only be solved by proper engineering applications of power, improved machinery, drainage, irrigation, and better living conditions
6. There is now an active cooperation between the existing agricultural engineering divisions in the agricultural colleges, experiment stations, and the present Division of Agricultural Engineering, Bureau of Public Roads, engaged in improving research, teaching, and extension methods, and avoiding duplication in projects undertaken
7. Should the Division of Agricultural Engineering be placed in a department other than the Department of Agriculture it would be extremely difficult, if not impossible to retain the proper contact with the state divisions of agricultural engineering now all connected with either agricultural colleges or experiment stations
8. It would be practically impossible to secure the active cooperation, such as now exists, of bureaus within the De-

Engineering be removed to another department."

The letter was signed for the Executive Committee of the College Section of the American Society of Agricultural Engineers by F. W. Ives, professor of agricultural engineering, Ohio State University, chairman; J. B. Davidson, professor of agricultural engineering, Iowa State College; O. W. Sjogren, professor of agricultural engineering, University of Nebraska; William Aitkenhead, professor of farm mechanics, Purdue University; E. R. Raney, professor of agricultural engineering, North Carolina Agricultural College; R. U. Blasingame, professor of farm machinery, Pennsylvania State College; and S. H. McCrory, engineer in charge, division of agricultural engineering, bureau of public roads, U. S. Department of Agriculture.

The program of the College Section at the next annual meeting of the Society in December was discussed and the following is recommended for discussion, under the general heading "Better Methods of Instruction:"

1. Organization of departments of agricultural engineering
2. Place of field demonstration in instruction
3. Use of visual instruction (motion pictures)
4. Use of trade literature by colleges
5. Text books and laboratory outlines
6. Short course instruction
7. Extension instruction

First Woman Member

THE first woman to be elected to membership in the American Society of Agricultural Engineers and, so far as the editors know, to any engineering society, is Mrs. Mary A. Ives, household equipment specialist for the Agricultural Engineering Company, Columbus, Ohio. Mrs. Ives, whose membership is of associate grade, holds a bachelor's degree in home economics from the Ohio State University, class of 1915, of which she was an honor student.

Mrs. Mary A. Ives, Assoc. A. S. A. E.

In addition to the management of her own household Mrs. Ives has gathered a fund of information and experimental data covering the mechanical equipment of the household, including such items as washing machines, vacuum cleaners and similar modern devices which should be engineered to their work and for the use of which the modern home should be designed. In addition to consulting service in this field she checks all house plans produced by the architects of the company with reference to floor arrangements of all fixtures, furnishings and equipment. Mrs. Ives is the wife of Prof. Frederick W. Ives, head of the department of agricultural engineering, Ohio State University, and president of the Agricultural Engineering Company.

The application of engineering principles to the household and its equipment has been too long neglected. That there is room for improvement is shown by the following remarks of Mrs. Ives in addressing a group of agricultural engineers:

"I have discovered in working with household equipment that it is designed by men who have but little experience with the processes involved. Washing machines are built from the standpoint of sales talk or manufacturing expediency rather than from the housewife's standpoint. Clutches and controls are poorly designed and inconveniently located. As with every other new industry there is a great deal to be learned from the consumer."

The Society is glad to welcome as a member one who can present not only the preferences and requirements of the housewife but can apply engineering precision in giving due weight to the various considerations involved, and it is reasonable to expect that her work marks the beginning of more thorough coordination between home and appliance design.

Annual Meeting Arrangements

DEFINITE arrangements have been made to hold the next annual meeting of the Society in the Auditorium Hotel, Chicago, December 27, 28, and 29. President E. A. White has appointed the following committee on arrangements: E. J. Baker, Jr., "Farm Implement News," Masonic Temple, Chicago, chairman; K. J. T. Ekblaw, and W. G. Kaiser.

Work is already under way on the program for the next annual meeting, and with the plans contemplated by the Meetings Committee our next meeting promises to be the biggest and best that the Society has held.

Suggestions for Annual Meeting Wanted

AS ANNOUNCED in the May number of AGRICULTURAL ENGINEERING, the general plan of the 1921 annual meeting of the American Society of Agricultural Engineers (December 27, 28, and 29) is to devote the afternoon of December 27 to the Reclamation Section and the evening to the College Section, the morning and afternoon of December 28 to farm structures, the evening to the banquet, and the morning and afternoon of December 29 to farm power and machinery.

The Meetings Committee is now working out the details of the program, based on the above general plan, with the hope that this year's meeting will be larger and better than ever. The details of the program for the Reclamation Section are under the direction of David P. Weeks, chairman of the Drainage Committee, Mitchell, South Dakota, while W. G. Kaiser, chairman of the Farm Structures Committee, Portland Cement Association, Chicago, is working out the program session on farm structures.

We cannot have the best meeting, however, without the hearty cooperation of everyone in the Society. Just at this time those in charge of the program are most anxious to have everyone send in worth-while suggestions for papers and speakers. Perhaps you have in mind some live subject which

partment of Agriculture, should the Division of Agricultural

you think ought to be brought up for discussion and investigation, and the Meetings Committee would like very much to have you send this in. If you can also give us the names of one or more men who would be competent to prepare a paper on the subject so much the better. All suggestions should be sent promptly to Secretary Frank P. Hanson, Ames, Iowa, or to I. W. Dickerson, chairman of the Meetings Committee, Charles City, Iowa.

Publishing Arrangements for the Journal

FOLLOWING the action taken by the Council of the American Society of Agricultural Engineers at its meeting in Davenport in April, and reported in the May number of AGRICULTURAL ENGINEERING, an agreement was consummated June 1 between the Society and The POWER FARMING Press, St. Joseph, Michigan, for the publishing of AGRICULTURAL ENGINEERING for a period of three years. As provided in this arrangement, Raymond Olney, as chairman of the Publication Committee, will act in the capacity of publication manager for the Society and will direct, subject to approval of the Council, the advertising sales efforts on our Journal in addition to the editorial work of which he has had charge since January 1 of this present year. All communications, etc., pertaining to editorial and advertising matters should hereafter be addressed direct to Mr. Olney at St. Joseph, Michigan.

Left-Hand-Plow Investigation

A CONFERENCE was held in Chicago May 20 to outline a definite program for conducting the left-hand plow investigation which the American Society of Agricultural Engineers is undertaking at the request of the plow and tillage implement department of the National Implement and Vehicle Association. The program which was agreed upon at that time is substantially as follows:

1. A complete resume is to be made of the progress made in connection with the elimination of the left-hand plow and the efforts made to reinstate it up to the time the National Implement and Vehicle Association asked the Society to investigate the whole matter and make an unbiased report on the feasibility and advisability of eliminating the left-hand type entirely.

2. A list of the manufacturers who are at the present time building left-hand plows will be made up, which will also include what sizes were originally built and what have been eliminated.

3. Data will be secured on the percentage (by companies) of the left-hand plows to the right-hand type that are built today. This will also include the distribution of wheel and walking plows by counties in the United States.

4. Plow manufacturers will be asked to furnish facts and figures for the purpose of determining what economy is possible in manufacturing the right-hand type of plow exclusively, as against building both types. This data will be confined exclusively to the production of plows.

5. Both dealers and manufacturers will be asked to furnish complete information on the economy possible in the distribution of right-hand plows as against both the right-hand and left-hand types. This will involve such items as the carrying of stocks and transportation, such as higher rates on less than carload lots and delay of small shipments. Dealers in left-hand-plow territory will be asked why they want the left-hand plow and also if they are willing to cooperate in an effort for the complete elimination of this type.

6. An extensive investigation will be conducted among farmers in the left-hand-plow territory to determine the fundamental reasons why farmers want left-hand plows. It is anticipated that the information from farmers will be secured for the most part at least by extension workers in the state agricultural colleges in states where the left-hand plow is used. These extension workers by personal contact with farmers will secure the farmer's viewpoint first hand. The extension workers will also interview county agents and dealers, and from the result of such contact it will be possible for the committee in charge of the investigation to determine if the farmers' reasons for wanting the left-hand plow are justified. Field trials to substantiate such reasons are also contemplated.

Those attending the conference in Chicago were B. J. Kough, chairman of the plow and tillage implement department of the National Implement and Vehicle Association; President E. A. White of the Society; Prof. G. W. McCuen, chairman of the subcommittee on left-hand-plow investigation, and Raymond Olney, chairman of the Standards Committee.

Agricultural Engineering Department At Montana

A DEPARTMENT of agricultural engineering at the College of Agriculture and Mechanic Arts of the University of Montana has been established this year. The department is the outgrowth of a similar department established in the agricultural experiment station seven years ago. Following this certain courses in the subject were established at the college under the head of agronomy. These so-called agronomy courses have been taken over by the new department and others added to them. It is stated by H. E. Murdock, agricultural engineer in charge, that this development is in response to a demand by the citizens of Montana for more instruction dealing with tractors, farm buildings, irrigation, drainage, etc. The extension service of the college is adding a permanent man, an irrigation specialist, in agricultural engineering.

A Correction

THE first paragraph, page 104, May number of AGRICULTURAL ENGINEERING, article entitled "Farm Equipment Standardization From the Manufacturing Standpoint," By G. W. Crampton, should read as follows:

"The result of this standardization was as follows: Due partly to the steel, coal, and railway strikes of 1919 and partly to unprecedented demand for automobiles and other articles, the prices of pig iron, coal, coke, and other materials were sharply advanced in the latter part of 1919.***"

Also the following paragraph, which properly belonged between the second and third paragraphs on page 104, was omitted:

"Probably less than 80 per cent of the 1920 output could have been made under these circumstances. It is also estimated that inventories would have been 30 per cent greater at the end of the selling season by reason of carrying over unsaleable sizes. This result benefitted the users as well as the producers of farm machinery and was a large factor in the production of the large crop of 1920."

Personal Items of Members

R. A. RUTHERFORD, consulting engineer, Lyme, Connecticut, has just been granted a patent on his invention of a rotary plow and cultivator with automatic governor. He is at present working on an experimental machine. He is also devoting some of his time to the installation of septic tanks for sanitary sewage disposal in country homes.

IRWIN L. SAVESON has been elected secretary-treasurer of the student branch of the American Society of Agricultural Engineers at the Ohio State University for the school year 1920-1922.

E. E. WHALEY, has been selected as manager and director of the tractor demonstrations and winter shows for the coming year by the tractor show and demonstration committee of the tractor and thresher department of the National Implement and Vehicle Association. Mr. Whaley's headquarters will be at 753 Monadnock Block, Chicago.

Wanted—Correct Addresses of these Applicants for Membership

(Note: Mail is being returned from the addresses given below).

Donald McCluer, Box 302, West Raleigh, North Carolina
George J. Baker, 122 Theodore Street, Detroit, Michigan
J. D. Eggleston, 1638 Iowa Street, Dubuque, Iowa
Henry G. Cox, 117 Calendar Avenue, La Grange, Indiana

New Members of the Society

MEMBERS

Albert Chester Dann, manager experimental and designing department, Oliver Chilled Plow Works, South Bend, Indiana. Leonard J. Fletcher, assistant professor agricultural engineering, acting head of division, University of California, Davis, California.

Louis Gerbig Heimpel, chief, power-farming division, Ford Motor Company, Windsor, Ontario, Canada.

Clarence Charles Johnson, instructor, department of agricultural engineering, Washington State College, Pullman, Washington.

Harvey S. Looper, fieldman and assistant to the manager, Great Western Sugar Company, Lovell, Wyoming.

John Henry Swenehart, associate professor, agricultural engineering, University of Wisconsin, Madison, Wisconsin.

Jesse George Whitfield, engineering specialist, Demopolis, Alabama.

ASSOCIATES

Kenneth R. Ames, manager department of farm buildings, Gordon-Van Tine Company, Davenport, Iowa.

Ward Cretcher, instructor in soils, Oregon Agricultural College, Corvallis, Oregon.

Frank W. Fuller, advertising manager, Crane & Ordway Company, St. Paul, Minnesota.

JUNIOR MEMBERS

Mark Earl Simon, instructor in agricultural engineering, Allen Township Centralized Schools, Van Buren, Ohio.

Francis P. Spoor, Carnation Milk Products Company, Berlin, Wisconsin.

William Francis Maloney, student, Connecticut Agricultural College, Waterbury, Connecticut.

Applicants for Membership

Orsel Edwin Robey, extension specialist in drainage, Michigan Agricultural College, East Lansing, Michigan.

Arthur H. Carter, extension architect, Mississippi A & M College, Agricultural College, Mississippi.

P. Arthur Tanner, mechanical engineer, Carson, Iowa.

Floyd Earl Fogle, assistant professor in farm mechanics, Michigan Agricultural College, East Lansing, Michigan.

Chauncey W. Smith, associate professor of agricultural engineering, University of Nebraska, Lincoln, Nebraska.

H. Z. Rynerson, instructor in farm carpentry and mechanics, Iowa State College, Ames, Iowa.

Ed. Webb Farr, student and instructor, State College of Washington, Pullman, Washington.

George Clark Heston, designer, Roderick Lean Manufacturing Company, Mansfield, Ohio.

Daniel Cromer Heitshu, student, State College, Pennsylvania.

Homer Lester Boysel, mechanical draftsman, Farmers Independent Thresher Company, Springfield, Illinois.

Harry H. Bates, secretary, Bates Machine & Tractor Company, Joliet, Illinois.

Samuel H. Beckett, associate professor of irrigation, University of California, University Farm, Davis, California.

Robert W. Coffey, concrete and surfacing inspector, State Highway Commission, Granada, Colorado.

James Elmer Dunn, traveling representative for Ford Motor Company, San Francisco, California.

Ralph Herman Denman, assistant professor of rural engineering, Massachusetts Agricultural College, Amherst, Massachusetts.

Wayne M. Hart, research work and patent attorney, Cleveland Tractor Company, Cleveland, Ohio.

Adam Truman Holman, student, State College, Pennsylvania.

Ross Carnes Ingrim, teacher, University Farm, California.

Charles Leslie Osterberger, coordinator and teacher farm mechanics, Louisiana State University, Baton Rouge, Louisiana.

William Lincoln Rockwell, consulting irrigation engineer, Austin, Texas.

B. B. Robb, professor of rural engineering, College of Agriculture, Ithaca, New York.

Frank J. Sprung, implement salesman, John Deere Plow Works, Moline, Illinois.

Charles Edward Stoddard, engineer, Farmers Independent Thresher Company, Springfield, Illinois.

Clarence Emmet Shiplet, assistant superintendent, Roderick Lean Manufacturing Company, Mansfield, Ohio.

Cecil Everett White, student, University of Wisconsin, Madison, Wisconsin.

Frederick C. Warne, agricultural engineer and designer, Roderick Lean Manufacturing Company, Mansfield, Ohio.

Howard Lewis Waterman, assistant superintendent of experimental department, Emerson-Brantingham Company, Rockford, Illinois.

Roy Gould Cullen, student, Ohio State University, Columbus, Ohio.

Fred C. Eggers, student, Iowa State College, Ames, Iowa.

Stephen G. LaMar, Elmo, Missouri. Student, Iowa State College, Ames, Iowa.

Benton M. Stahl, student, Iowa State College, Ames, Iowa.

Louie Lanz, student, Iowa State College, Ames, Iowa.

George E. Parker, student, Iowa State College, Ames, Iowa.

Arthur Cobbledick, student, Iowa State College, Ames, Iowa.

Bruce Russell, student, Iowa State College, Ames, Iowa.

Eugene G. McKibben, student, Iowa State College, Ames, Iowa.

Hobart Beresford, student, Iowa State College, Ames, Iowa.

Harold P. Warrington, student, Iowa State College, Ames, Iowa.

Bryan Leigh Allan, student, Iowa State College, Ames, Iowa.

Hipolito Nagal Bonzo, student, Iowa State College, Ames, Iowa.

G. F. Holsinger, student, Iowa State College, Ames, Iowa.

I. P. Blauser, student, Ohio State University, Columbus, Ohio.

L. P. Hine, student, Ohio State University, Columbus, Ohio.

H. S. Scott, student, Ohio State University, Columbus, Ohio.

H. N. Rhoades, student, University of Nebraska, Lincoln, Nebraska.

Hugh E. Beall, student, University of Nebraska, Lincoln, Nebraska.

Your Journal

AGRICULTURAL ENGINEERING, the journal of the American Society of Agricultural Engineers, is ***your journal*** —"you" being the members of the Society.

It being "your journal" implies likewise a responsibility, does it not?

The Journal as the principal vehicle of the Society for the advancement of agricultural engineering in general and the dissemination of information and data in particular, is dependant on the members of the Society for furnishing material of special interest and value to agricultural engineers.

There is a wealth of valuable information and data along agricultural engineering lines that has never been put in circulation. Don't continue to hide your light under a bushel, members of the A. S. A. E., now that you have the right vehicle for getting it into the proper channels.

What will your first contribution be?